

9th Edition

# Rosen's

## Emergency Medicine

QUESTIONS AND ANSWERS

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## KEY CONCEPTS

- Anticipating the clinical course of the patient's condition and assessing the likelihood of deterioration are crucial to the decision to intubate, especially if the patient is to leave the ED for a period of time (eg, interfacility transfer, diagnostic testing).
- Assessment of the patient for potential difficulty with intubation, bag-mask ventilation (BMV), ventilation using an extraglottic device (EGD), and cricothyrotomy is an essential step before a neuromuscular blocker is administered. The mnemonics *LEMON*, *MOANS*, *RODS* and *SMART* can serve as useful aids.
- In the absence of a crash patient (agonal, unresponsive to laryngoscopy) or difficult airway, rapid sequence intubation (RSI) is the airway management method of choice for ED patients.
- Tube placement confirmation using end-tidal CO<sub>2</sub> (ETco<sub>2</sub>) is essential after intubation; failure to detect adequate quantities of exhaled CO<sub>2</sub> is evidence of esophageal intubation until proven otherwise.
- Videolaryngoscopy has transformed intubation by eliminating many of the traditional anatomic barriers to direct laryngoscopy. Practitioners responsible for emergency airway management should transition their routine airway management from direct laryngoscopy to videolaryngoscopy.
- Cricothyrotomy is indicated in the can't intubate, can't oxygenate failed airway situation and should be performed without hesitation once this has been identified. Delays may increase the likelihood or severity of hypoxic injury to the patient.
- Emergency airway management is evolving, and modern intubators should be aware of these fundamental changes. Videolaryngoscopy is replacing direct laryngoscopy as the tool of choice for emergency airway management. Etomidate is used in more than 90% of all RSIs, and rocuronium use has been increasing. EGDs, such as laryngeal mask airways, are continually evolving, offering additional options for rescue oxygenation of the failed airway.

## CHAPTER 1: QUESTIONS & ANSWERS

- 1.1. Which of the following is considered unreliable for assessing the need to establish an artificial airway?
- A. Absence of a gag reflex
  - B. Absence of swallowing on command
  - C. Level of consciousness
  - D. Patient's ability to phonate
  - E. Pooling of secretions in the oropharynx

**Answer: A.** The gag reflex can be absent in up to 25% of normal adults. Moreover, there is no evidence that the presence or absence of a gag reflex corresponds to a patient's ability to protect his or her airway. It should therefore not be used as an indicator of the need for intubation.

- 1.2. Which of the following is the most reliable overall method for confirmation of correct tube placement after endotracheal intubation?
- A. Bulb aspiration
  - B. Chest and gastric auscultation
  - C. Chest radiography
  - D. Detection of colorimetric or quantitative end-tidal carbon dioxide (ETCO<sub>2</sub>)
  - E. Measurement of exhaled volume

**Answer: D.** Detection of ETCO<sub>2</sub> after endotracheal intubation is the most reliable of the options listed for the confirmation of tube placement. (A fiberoptic scope passed through the endotracheal tube, with visualization of the tracheal rings, is the gold standard but is not generally required.) Limitations of colorimetric CO<sub>2</sub> detection should be appreciated in cardiac arrest patients. In these situations, a bulb aspiration device may provide helpful information, even though this technique is generally not as reliable as ETCO<sub>2</sub> detectors. The other listed options, traditional as they may be, are prone to failure and should not be relied on for confirmation of tube placement.

- 1.3. During rapid sequence intubation (RSI), what is the optimal time to wait between the administration of a pretreatment drug and administration of the induction agent and neuromuscular blocking agent?
- A. 1 minute
  - B. 2 minutes
  - C. 3 minutes
  - D. 4 minutes
  - E. 5 minutes

**Answer: C.** Three minutes is considered the optimal time to wait between the administration of a pretreatment drug and administration of the induction agent. If the clinical situation does not allow for this length of time between administrations, there may still be some benefit to administration of the pretreatment agent.

- 1.4. In which of the following conditions is succinylcholine contraindicated?
- A. Acute burn < 5 days
  - B. Acute head injury secondary to motor vehicle accident

- C. Acute spinal cord injury < 5 days
- D. Renal failure with a serum potassium level of 4.7 mEq/L
- E. Stable multiple sclerosis

**Answer: E.** Succinylcholine has been associated with severe fatal hyperkalemia when administered in specific clinical circumstances. The risk of succinylcholine-induced hyperkalemia in patients with denervation syndromes begins with the onset of disease and continues indefinitely. With respect to acute burns, trauma, stroke, spinal cord injury, and intraabdominal sepsis, the risk of hyperkalemia with succinylcholine use becomes evident 5 days after the onset of injury or disease process. Succinylcholine is not contraindicated in renal failure; however, known elevations in the potassium level may warrant use of another neuromuscular blocking agent.

- 1.5. Which of the following conditions prevents reliable use of colorimetric capnometers for the detection of esophageal intubation in 25% to 40% of cases?
- A. Acute asthma exacerbation
  - B. Cardiac arrest
  - C. Chronic obstructive pulmonary disease exacerbation
  - D. Head trauma
  - E. Pneumonia

**Answer: B.** Colorimetric capnometers detect CO<sub>2</sub> and can be used to confirm tracheal intubation. The absence of CO<sub>2</sub> detection indicates failure to intubate the trachea and necessitates reintubation, except in the low-perfusion state of cardiac arrest, when quantities of CO<sub>2</sub> returned to the lungs may be insufficient to produce a color change in the capnometer. This situation occurs in 25% to 40% of intubated cardiac arrest patients. The placement of the tube needs to be confirmed by clinical means, revisualizing placement, or the tube needs to be removed and the patient reintubated.

- 1.6. Until how long after an acute burn is succinylcholine considered safe to use for RSI?
- A. 30 minutes
  - B. 12 hours
  - C. 24 hours
  - D. 48 hours
  - E. 5 days

**Answer: E.** Succinylcholine can produce severe (and fatal) elevations in serum potassium levels after administration in patients with burns. However, this vulnerability to succinylcholine-induced hyperkalemia is not clinically significant until at least 5 days after the acute burn. As a result, succinylcholine remains the paralytic of choice if rapid sequence intubation occurs less than 5 days after the burn.

## KEY CONCEPTS

- There have been no demonstrated outcomes differences between BiPAP and CPAP. After appropriate patient selections, begin NIPPV with an inspiratory pressure setting of 10 cm of water and expiratory pressure of 5 cm of water and evaluate frequently for tolerance and need to titrate up or down.
- Pressure controlled (PC) ventilation delivers breaths at a predetermined pressure, which might result in low volume delivery, while volume controlled (VC) delivers a predetermined inspiratory volume, which might lead to excessive pressures. Continuous mandatory ventilation (CMV) delivers a required number and volume of breaths per minute while synchronized intermittent-mandatory ventilation (SIMV) synchronizes mandatory breaths with spontaneous breaths.
- Noninvasive ventilatory support is often adequate for reversal of impending respiratory failure and should be considered as the first-line therapy for patients with exacerbations of chronic obstructive pulmonary disease and acute cardiogenic pulmonary edema in whom immediate intubation is not required. When non-invasive ventilation is attempted for patients with pneumonia, it should be abandoned in favor of intubation with mechanical positive-pressure ventilation unless the patient is clearly improving. Prolonged use of non-invasive ventilation that ultimately fails is associated with worse outcomes for patients than when intubation is undertaken earlier.
- Invasive mechanical ventilation is not without consequence and requires dynamic, ongoing management. After intubation, blood gas analysis should be performed to confirm appropriate ventilation and provide correlation with noninvasive monitoring of oxyhemoglobin saturation and end-tidal CO<sub>2</sub>. In addition, positive pressure can have adverse hemodynamic consequences. Elevated lung pressures can be deleterious and plateau pressure should be maintained below 30 cm H<sub>2</sub>O whenever possible, by adjusting ventilator settings. Progressive elevation in ventilation pressures prompts consideration of ventilator circuit obstruction, obstruction at any point of the airway, increased bronchospasm, mainstem intubation, tension pneumothorax or hemothorax, increased chest wall resistance (from a constricting device or intrinsic chest wall), or rigidity (as from high doses of fentanyl). Suddenly reduced ventilation pressures are often accompanied by increasing hypoxemia and indicate ventilator circuit leak or faulty connection, endotracheal tube cuff leak, accidental extubation, or esophageal intubation.
- The Richmond Agitation Sedation Score (RASS) or a similar scoring system should be used to manage sedation and analgesia of the mechanically ventilated patient to avoid unnecessary use of prolonged neuromuscular blockade. When RASS is used, a target score of -2 to 0 avoids both over and under sedation.



## CHAPTER 2: QUESTIONS &amp; ANSWERS

- 2.1. Which of the following is the most important consideration in the decision to initiate noninvasive positive-pressure ventilation (NPPV)?
- Degree of acidosis
  - Degree of respiratory distress
  - Hemodynamic profile
  - Level of consciousness
  - Underlying etiology of respiratory failure

**Answer: B.** Although NPPV will be helpful for many patients in distress, the need for emergent intubation is an absolute contraindication to NPPV. Both hemodynamic profile and level of consciousness are important determinants in the decision to implement NPPV, but both are relative (rather than absolute) contraindications to its use. Patients with chronic obstructive pulmonary disease (COPD), acute cardiogenic pulmonary edema (ACPE), and asthma are more likely to show benefit with NPPV than patients with pneumonia, but NPPV can be initiated for any patient with respiratory distress. Patients with hypoxia or hypercarbia may be acidemic, but the decision to initiate NPPV will be predicated on mental status and work of breathing rather than on degree of acidosis alone.

- 2.2. Which of the following is a potential adverse effect of positive-pressure ventilation?
- Decreased mean intrathoracic pressure
  - Decreased ventilation/perfusion ratio
  - Increased cardiac output
  - Increased glomerular filtration rate
  - Increased work of breathing

**Answer: E.** Positive-pressure ventilation (PPV) is associated with several complications. Some of these can quickly become life-threatening. This reality underscores the importance of familiarization with the common problems that arise as a result of PPV. Most complications result from changes in thoracic physiology when positive pressure is present for part or all of the respiratory cycle. Potential adverse effects of PPV include an increased work of breathing because of asynchrony or improperly set triggers, an increase in intrathoracic pressure, decreased venous return to the heart and decreased cardiac output, an increased ventilation/perfusion ratio, air trapping and intrinsic positive end-expiratory pressure, barotrauma, decreased renal blood flow and glomerular filtration rate with fluid retention, nosocomial infections of the lungs and sinuses, respiratory alkalosis, and agitation and increased respiratory distress.

- 2.3. What is the primary physiologic effect of applying positive end-expiratory pressure (PEEP) during mechanical ventilation?
- Decrease cardiac output
  - Decrease intrapulmonary shunting
  - Decrease ventilation/perfusion mismatch
  - Increase functional residual capacity
  - Increase partial pressure of oxygen ( $P_{aO_2}$ )

**Answer: D.** Although all of these effects can be attributed to the application of PEEP, its primary physiologic effect is to increase functional residual capacity (FRC) by maintaining patency of injured or flooded alveoli that would otherwise collapse at the end of exhalation. Increasing the FRC may improve both oxygenation and lung compliance. PEEP increases  $P_{aO_2}$  at a constant fraction of inspired oxygen ( $F_{iO_2}$ ) by decreasing intrapulmonary shunting and ventilation/perfusion mismatch. One of the potential adverse effects to PEEP is decreased cardiac output.

- 2.4. Regarding a patient who develops acute distress on mechanical ventilation, which of the following is the most accurate?
- Accidental extubation is a common cause of increased airway pressure.
  - Anaphylaxis would cause immediate increases in both peak inspiratory pressure (PIP) and plateau pressure (Pplat).
  - All patients in distress should be immediately removed from the ventilator and bagged.
  - Compared to patients with restrictive lung disease, patients with obstructive lung disease are more likely to decompensate because of inappropriately set respiratory rate.
  - Presumptive needle thoracostomy is indicated for all hemodynamically unstable patients.

**Answer: D.** One of the most life-threatening complications of mechanical ventilation is loss of adequate cardiac output because of elevated intrathoracic pressure from intrinsic PEEP (iPEEP). Intrinsic PEEP can be precipitated by a respiratory rate that is too high, which does not allow patients to fully exhale before the delivery of another breath. Patients with obstructive lung disease such as COPD or acute asthma are particularly sensitive to this phenomenon, also known as “breath stacking.” Although patients with restrictive lung disease may develop iPEEP with an inappropriate respiratory rate, this is much more likely to occur in patients with obstructive conditions. If patients are not hemodynamically unstable, they do not need to be removed from the ventilator, and in hemodynamically unstable patients, pneumothorax should only be presumptively treated if removing the patient from the ventilator does not improve the situation. Accidental extubation is a common cause of decreased airway pressures, and although anaphylaxis would cause increases in PIP, it would not typically cause increases in Pplat.

## KEY CONCEPTS

- Acute pain is an urgent condition for the patient. Pain should be rapidly assessed, treated, and frequently reassessed in tandem with diagnostic evaluations (see Fig. 3.7).
- Therapy for acute pain is different than for chronic pain (see Box 3.3). Chronic pain treatment should be undertaken in consultation with the provider(s) responsible for the patient's long-term management. In general, opioid analgesic agents should not be administered in the ED or prescribed for outpatient therapy for chronic pain patients unless the plan is agreed to by the responsible outpatient provider.
- Titrated IV opioid analgesics are the principal therapeutic approach for the treatment of moderate and severe acute pain. When intravenous access is not indicated or attainable, SC administration is preferable to the IM route (see Box 3.5).
- Oral oxycodone, with an onset of action similar to that of IM or SC opioids, can be used for moderate pain when the IV route is not otherwise needed. Oxycodone and other oral opioids should be administered and prescribed as a single-drug preparation, not as part of a combination.
- Ambulatory treatment with opioids should be confined to the period of acute pain. Most opioid prescriptions from the ED for acute injury (eg, burr, fracture) should be for 3 to 5 days, after which the patient is transitioned to nonopioid analgesia or reevaluated by an outpatient provider.
- Acetaminophen and NSAIDs should be added to pain therapy, when not contraindicated. Their analgesic effects are additive to those of opioids and to each other.
- Morphine, fentanyl, and hydromorphone are the preferred parenteral opioid agents in the ED. Meperidine should not be used.
- There is no evidence to support the concept that diagnosis based on physical examination findings will be impaired by the administration of opioid pain medications to achieve reasonable patient comfort.
- There is no validity to the belief that morphine causes more smooth muscle spasm than other opioids. Morphine is safe and appropriate for patients with acute biliary or renal colic.
- Patients who are known to be diverting or abusing opioids should not be prescribed opioids for use as outpatients. Patients with chronic pain syndromes, or those with chronic conditions that may cause acute pain (eg, dental caries), should be offered alternative pain management options, and opioids generally should be avoided.
- Topical and local anesthetics can be used to treat pain associated with most ED procedures and should be considered for use in isolated painful conditions.
- Low tissue pH (5 or 6) in infected tissue impairs the effectiveness of local anesthesia.

## CHAPTER 3: QUESTIONS &amp; ANSWERS

- 3.1. Which of the following statements is true regarding pain transmission?
- Cardiac pain is transmitted via the sympathetic system.
  - Central poststroke neuropathic pain is associated with parietal infarcts.
  - Descending modulation of pain is mediated primarily through  $\gamma$ -aminobutyric acid (GABA).
  - Peripheral neurotransmitters include prostaglandins, histamines, and substance P.
  - The dorsal columns play no role in pain transmission.

**Answer: A.** As a general rule, all visceral pain is carried via sympathetic afferents to ganglia and then to the spinal cord. Prostaglandins, substance P, and histamine sensitize peripheral afferents but are not neurotransmitters. The dorsal column tracts can down-modulate ascending pain signals. Central poststroke pain is clinically seen most often after thalamic strokes. Descending tracts that modulate pain processing at the dorsal horn use norepinephrine and serotonin, with the effect of the former being most important regarding analgesia.

- 3.2. Which of the following analgesics is matched with the correct feature?
- Fentanyl—prolonged QT interval on electrocardiography
  - Hydromorphone—active metabolites
  - Meperidine—muscle rigidity
  - Oxycodone—serotonin syndrome
  - Propoxyphene—anticholinergic toxicity

**Answer: D.** Oxycodone has been associated with serotonin syndrome when coadministered with selective serotonin reuptake inhibitor (SSRI) medications. The following are the other correct associations:

Meperidine—anticholinergic toxicity, active metabolites  
 Propoxyphene—prolonged QT interval on electrocardiography  
 Fentanyl—muscle rigidity (chest wall)  
 Hydromorphone—inactive metabolite

- 3.3. A 32-year-old male patient undergoing treatment for an ankle sprain returns to the emergency department (ED) because of inadequate pain relief from the medicines he was prescribed. He is currently taking oxycodone, 10 mg PO every 4 hours, and ibuprofen, 400 mg every 4 hours. What is the next most appropriate medicine to add to his pain treatment regimen?
- Add acetaminophen, 650 mg q4h.
  - Add tramadol, 50 mg PO q4h.
  - Increase ibuprofen to 800 mg.
  - Increase oxycodone to 15 mg.
  - Replace oxycodone with hydrocodone, 15 mg PO q4h.

**Answer: A.** Acetaminophen provides additive analgesia to nonsteroidal antiinflammatory drugs (NSAIDs) and opioids, with few adverse effects at low doses, and it should be incorporated in acute pain treatment when not contraindicated. The pain-relieving effects of ibuprofen have not been shown to be greater when 800 mg is used versus 400 mg, so increasing the dose of ibuprofen is unlikely to improve pain relief and will increase the risk of adverse effects of the NSAIDs. An increased dose of oxycodone would result in improved pain relief but increases the risk of adverse effects; it should be tried after other nonopioid treatments have failed. In this case, acetaminophen should be attempted first before increasing the oxycodone dose. Tramadol may improve pain relief and would be additive to the opioid effect of the oxycodone but would not be indicated before acetaminophen because of its high rate of dizziness and nausea. The pain-relieving effects of opioids at equianalgesic doses usually do not vary among individuals, and switching from an equivalent dose of one opioid to another is unlikely to improve pain treatment. Changing to hydrocodone, therefore, would be unlikely to decrease the patient's pain.

## KEY CONCEPTS

- Safe, effective PSA requires high-level skills and information and sound protocols, including patient monitoring.
- Patients should be discharged in the company of a responsible adult and should remain with a responsible adult for 4 to 8 hours after recovery and discharge.
- Propofol is the agent of choice for deep sedation in the ED but requires supplementation with an opioid analgesic when a painful procedure is planned.
- Absence of a preprocedure fasting period is not a contraindication to procedural sedation for an emergent and/or time-sensitive condition.
- Pulse oximetry is mandatory during sedation, and end-tidal CO<sub>2</sub> should be monitored if moderate or deep sedation is the goal. Oxygen should be administered to patients undergoing procedural sedation.

## CHAPTER 4: QUESTIONS &amp; ANSWERS

4.1. When do most adverse events associated with emergency department procedural sedation occur?

- A. During the manipulation or intervention
- B. 5 to 20 minutes after the last sedative dose
- C. 20 to 30 minutes after the last sedative dose
- D. 30 to 60 minutes after the last sedative dose
- E. 60 to 90 minutes after the last sedative dose

**Answer: B.** High-risk times are 5 to 20 minutes after the last medication administration and at the completion of the procedure, when there is no longer a painful stimulus but the patient remains sedated.

4.2. Which of the following modalities has proven most effective for monitoring patients undergoing procedural sedation?

- A. Capnometry or capnography
- B. Cardiac rhythm monitoring
- C. Continual direct visual observation of qualitative clinical signs
- D. Documented respiratory rate
- E. Pulse oximetry

**Answer: C.** The patient's ability to follow commands in response to varied levels of stimulation and direct observation of the ventilatory status have been the most reliably documented methods of assessing the level of consciousness during procedural sedation. Pulse oximetry is a reliable adjunct, but it identifies hypoventilation late, especially when used with supplemental oxygen. Cardiac monitoring has been shown to be helpful in older patients or in those with a history of cardiac disease, but there is no evidence that it is of any benefit in young healthy patients. End-tidal carbon dioxide (CO<sub>2</sub>) monitoring has been shown to be useful to detect inadequate ventilation earlier than oximetry, especially when direct observation of the patient is difficult, but no studies have demonstrated an effect on clinical outcome to date. The American Society of Anesthesiologists (ASA) has updated its procedural sedation standards to include capnography during moderate or deep sedation, in addition to the continual observation of qualitative clinical signs. Respiratory rate alone is an insensitive indicator of the adequacy of ventilation.

4.3. Which of the following statements is most accurate regarding the use of fentanyl for procedural sedation?

- A. Chest wall rigidity is a common occurrence but may be reversed with naloxone.
- B. For deep sedation, a single dose of 1 to 2 µg/kg IV is often given before sedation to achieve good pain control. A smaller dose of sedative agent may then be added and titrated to effect.
- C. Rapid IV administration is generally safe.
- D. Respiratory depression is less likely with fentanyl than with an equipotent dose of morphine.
- E. Sufficient analgesia is generally attained with dosages of 5 to 10 µg/kg intravenous (IV).

**Answer: B.** For deep sedation, less respiratory depression is generally observed if a single pain-relieving dose of fentanyl is used before sedation, followed by small titrated doses of a sedative agent. Sufficient analgesia is generally attained with fentanyl dosages of 1 to 2 µg/kg IV. Rapid IV administration of large doses is more likely to precipitate respiratory depression or arrest. Chest wall rigidity is very rarely seen and generally only with large, rapid, IV boluses of more than 7 µg/kg IV. If severe chest wall rigidity syndrome is precipitated, it often requires paralysis to ventilate the patient adequately. It is not reversed with naloxone. Equivalent dosages of morphine show more histamine release and hypotension than fentanyl but have similar respiratory depression potential.

4.4. Which of the following agents is matched with the correct associated side effect?

- A. Etomidate—limited (30-minute) duration of sedation
- B. Ketamine—laryngospasm
- C. Methohexital—venoirritation
- D. Pentobarbital—seizures
- E. Propofol—myoclonus

**Answer: B.** Ketamine has been associated with laryngospasm in children younger than 3 months and those with a respiratory infection. The following are the other correct associations:

- Methohexital—seizures
- Propofol—venoirritation
- Pentobarbital—30-minute duration
- Etomidate—myoclonus

- 4.5. Which of the following statements regarding the use of ketamine is false?
- A. Benzodiazepine coadministration has not been shown to reduce the incidence of emergence phenomenon in children.
  - B. Despite increased secretions, airway reflexes are generally well maintained.
  - C. Hypotension is common.
  - D. Profound analgesic and sedative effects occur with minimal respiratory depression.
  - E. Repeat doses are well tolerated in longer procedures.

**Answer: C.** Ketamine increases the release of catecholamines on administration and supports blood pressure well. It also decreases smooth muscle tone in the bronchial tree and may have a benefit in patients with reactive airways disease. Several studies have failed to show benefit with the concurrent administration of low to moderate dosages of benzodiazepines in preventing emergence phenomenon in children. These studies have shown a slightly increased risk of side effects. Their routine use is discouraged and should be reserved for the actual treatment of severe emergency phenomenon.

- 4.6. Which of the following statements regarding the use of propofol is true?
- A. Propofol has a long duration of action and provides significant analgesia.
  - B. Propofol has significant antiemetic properties.
  - C. Propofol is cerebroprotective.
  - D. Propofol is well tolerated in volume-depleted patients.
  - E. The use of ketofol (ketamine in combination with propofol) is clinically superior to the use of propofol alone.

**Answer: B.** Propofol is an ultra-short-acting, sedative-hypnotic, cerebroprotective agent with no analgesic but profound antiemetic properties. Its adverse effects include dose-dependent respiratory depression, apnea, hypotension, and pain on injection. Preload-dependent patients are particularly susceptible to hypotension. Its combined use with ketamine is common. The two agents are thought to have synergistic effects that balance each other's deficits. Their combined use has been shown to improve provider satisfaction, sedation quality, and decrease emesis but has not been shown to be clinically superior to either agent used alone in regard to respiratory depression, airway complications, or improved recovery times.

- 4.7. Which of the following statements is true regarding the need for fasting before procedural sedation?
- A. A 6-hour period of fasting is required after the ingestion of liquids or solids before procedural sedation.
  - B. Preprocedural fasting is required in all cases.
  - C. The recommendation for preprocedural fasting is based on controlled trials involving patients undergoing procedural sedation.
  - D. The risk of vomiting and loss of the airway protective reflexes is an extremely rare occurrence during procedural sedation.
  - E. There is an increased risk of aspiration during procedural sedation after a liquid or solid meal.

**Answer: D.** The ASA currently recommends a period of 2 hours after ingestion of clear liquids, 4 hours after ingestion of breast milk, and 6 hours after the ingestion of other liquids or solids before the performance of procedural sedation. This recommendation is based on expert consensus and has been extrapolated from data on patients receiving general anesthesia and manipulation of the airway during intubation and extubation. There are no published studies showing an increased risk of aspiration after a liquid or solid meal nor benefits of fasting before procedural sedation. Large studies have shown no clinically significant differences with airway complications, emesis, or other adverse effects among groups of patients stratified by their preprocedural fasting status. The risks of procedural sedation should be balanced against the risks of delaying a time-sensitive procedure.



## KEY CONCEPTS

- Monitoring modalities, when used appropriately, help identify the effectiveness of interventions, predict deterioration, track the patient's clinical course, and inform clinical decision making.
- Noninvasive blood pressure monitors remain the standard for ongoing measurement of dynamic change. A single episode of hypotension is predictive of subsequent hemodynamic compromise. Despite generally high accuracy and dependability of blood pressure monitoring devices, manual blood pressure may be required at times to verify sudden changes in blood pressure measurements or when readings fluctuate rapidly, suggesting inaccuracy of the automated device.
- Due to the nonlinear relationship of the oxyhemoglobin dissociation curve, pulse oximeters are helpful for screening and monitoring patients but are not an accurate measure of  $P_{aO_2}$  in hypoxic patients and thus should be used with caution.
- In the setting of MetHb or COHb exposure, the pulse oximeter may read falsely elevated, so a CO oximeter is necessary to distinguish oxygenated and deoxygenated blood from other dyshemoglobinemias.
- Capnography supplements oximetry by providing useful information regarding pathologic conditions and response to therapy. It is highly correlated with cardiac output and therefore is a good indicator of the adequacy of cardiopulmonary resuscitation in arrest victims.
- Capnography is also useful in spontaneously breathing patients. It can be a good indicator of perfusion, ventilatory response to therapy in respiratory distress patients, adequacy of ventilation during procedural sedation, and rapid assessment and response to therapy in patients with metabolic derangements.
- Monitoring modalities, when used appropriately, help identify the effectiveness of interventions, predict deterioration, track the patient's clinical course, and inform clinical decision making.
- Noninvasive blood pressure monitors remain the standard for ongoing measurement of dynamic change. A single episode of hypotension is predictive of subsequent hemodynamic compromise. Despite generally high accuracy and dependability of blood pressure monitoring devices, determining blood pressure manually may be required at times to verify sudden changes in blood pressure measurements or when readings fluctuate rapidly, suggesting inaccuracy of the automated device.
- Due to the nonlinear relationship of the oxyhemoglobin dissociation curve, pulse oximeters are helpful for screening and monitoring patients but are not an accurate measure of  $P_{aO_2}$  in hypoxic patients and thus should be used with caution.
- In the setting of MetHb or COHb exposure, the pulse oximeter reading may be falsely elevated; thus, a CO oximeter is necessary to distinguish oxygenated and deoxygenated blood from other dyshemoglobinemias.

## CHAPTER 5: QUESTIONS &amp; ANSWERS

- 5.1. A 27-year-old firefighter presents with a headache, chest pain, and severe shortness of breath after working at the scene of a house fire. The physical examination is remarkable for a blood pressure of 155/90 mm Hg, heart rate of 110 beats/min, respiratory rate of 28 breaths/min, oxygen ( $O_2$ ) saturation of 98% on room air, and clear lungs. The chest radiograph is unremarkable. Which of the following may be responsible for a normal  $O_2$  saturation despite such respiratory stress?
- Carboxyhemoglobin
  - Cyanide
  - Melanin
  - Methemoglobin
  - Methylene blue

**Answer: A.** Pulse oximetry is based on differences in the optical transmission spectrum of oxygenated and deoxygenated hemoglobin. Pulse oximeters measure the pulse variation in red and infrared light transmitted through a tissue bed. Data averaged over several arterial pulse cycles are then presented as saturation. Carboxyhemoglobin (COHb) contributes to light absorption and causes errors in oximetry readings. The pulse oximeter senses COHb as though it were mostly oxyhemoglobin and provides a falsely high reading.

- 5.2. A 17-year-old male presents with fatigue, bluish-colored skin, and mild shortness of breath. He has recently been to the dentist to have his molars removed and reports that his only medications are ibuprofen and multiple applications of over-the-counter topical pain relief. The physical examination is remarkable for a blood pressure of 137/85 mm Hg, heart rate of 95 beats/min, respiratory rate of 20 breaths/min, and  $O_2$  saturation of 85% on room air. The chest radiograph is unremarkable. Which of the following is most likely responsible for this  $O_2$  saturation in the context of this presentation?
- Carboxyhemoglobin
  - Cyanide
  - Lactate
  - Methemoglobin
  - Methylene blue

**Answer: D.** As with carboxyhemoglobin, methemoglobin (MetHb) contributes to pulse oximetry light absorption and causes an error in oximetry readings. MetHb produces a large

pulsatile absorbance signal at red and infrared wavelengths. This forces the absorbance ratio toward unity, which corresponds to an oxygen saturation measured by pulse oximetry ( $SpO_2$ ) of 85%. Thus, with high levels of MetHb, the  $SpO_2$  is erroneously low when the arterial saturation is higher than 85% and erroneously high when the arterial saturation is less than 85%.

- 5.3. Which of the following conditions would lead to a prolongation of the rapid upstroke phase of the capnography curve?
- Bronchospasm
  - Pneumothorax
  - Pregnancy
  - Pulmonary embolism
  - Sepsis

**Answer: A.** The rapid upstroke phase of the capnography curve represents the transition from inspiration to expiration and the mixing of dead space and alveolar gas. Prolongation of this phase occurs with obstruction to expiratory gas flow (eg, obstructive lung disease, bronchospasm, kinked endotracheal tube) or leaks in the breathing system.

- 5.4. Which of the following may lead to false-negative results when capnometry is used to confirm intubation of the trachea?
- Bicarbonate infusion
  - Cardiac arrest
  - Chronic obstructive pulmonary disease
  - Pneumothorax
  - Pulmonary embolism

**Answer: B.** Capnometry can confirm intubation of the trachea but may give false-negative results in cardiac arrest if delivery of carbon dioxide ( $CO_2$ ) from the periphery to the lungs is sufficiently diminished. Misleading end-tidal  $CO_2$  ( $ET_{CO_2}$ ) readings causing false-positive results can occur with esophageal intubation after bag-mask ventilation and ingestion of carbonated beverages or antacids. However, detection of  $ET_{CO_2}$  usually ceases after six breaths and, if capnography is used, the tracings look abnormal.  $ET_{CO_2}$  is also falsely elevated for 5 to 10 minutes after injection of sodium bicarbonate. In nonarrest settings, the  $ET_{CO_2}$  approaches 100% sensitivity and specificity in confirming correct tube placement.

## CHAPTER 6: QUESTIONS &amp; ANSWERS

- 6.1. Which of the following is considered one of the empirical criterion for the diagnosis of circulatory shock?
- Partial pressure of carbon dioxide ( $\text{Paco}_2$ ) < 40 mm Hg
  - Partial pressure of oxygen ( $\text{Pao}_2$ ) < 55 mm Hg
  - Serum lactate level < 4 mM/L
  - Systolic blood pressure (SBP) < 100 mm Hg
  - Urine output < 0.5 mL/kg/h

**Answer: E.** Four of the following criteria should be met for the diagnosis of circulatory shock:

- Ill appearing or altered mental status
  - Heart rate > 100 beats/min
  - Respiratory rate > 20 breaths/min or  $\text{Paco}_2$  < 32 mm Hg
  - Arterial base deficit < -4 mEq/L or lactate level > 4 mM/L
  - Urine output < 0.5 mL/kg/h
  - Arterial hypotension > 20 min duration
- 6.2. Which of the following, when present and in the setting of suspected or confirmed infection, helps distinguish severe sepsis from systemic inflammatory response syndrome?
- Heart rate > 90 beats/min
  - Hypotension
  - $\text{Paco}_2$  < 32 mm Hg
  - Temperature < 36°C
  - >10% band neutrophilia

**Answer: B.** The diagnosis of severe sepsis is made in patients who meet the criteria for systemic inflammatory response syndrome (SIRS) with suspected or confirmed infection and associated with organ dysfunction or hypotension. The organ dysfunction

mentioned may include the presence of lactic acidosis, oliguria, and/or altered mental status. The diagnosis of SIRS is made when two or more of the following are present:

- Temperature > 38°C or < 36°C
- Heart rate > 90 beats/min
- Respiratory rate > 20 breaths/min or  $\text{Paco}_2$  < 32 mm Hg
- White blood cell count > 12,000/mL, < 4,000/mL, or > 10% band neutrophilia

- 6.3. An 18-year-old unrestrained driver is transported to the emergency department (ED) after being thrown from his vehicle during a motor vehicle collision. He was intubated in the field and received an intravascular bolus of 3 L of normal saline before arrival to the ED. His initial Glasgow Coma Score (GCS) is 7, and his blood pressure on arrival is 80/50 mm Hg. Which of the following would be the most appropriate to initiate immediately on arrival to the ED?
- Dobutamine
  - Dopamine
  - Hetastarch
  - Norepinephrine
  - Packed red blood cell (PRBC) transfusion

**Answer: E.** In patients with signs of hemorrhagic shock and suspected central nervous system trauma or GCS < 9, immediate PRBC transfusion should be initiated. This assists with volume expansion and oxygen delivery to the brain. Pressors and positive inotropes will be of little benefit before volume replacement, and hetastarch has no proven benefit for initial resuscitation in head injury patients.



## KEY CONCEPTS

- Neuronal injury is a dynamic process that continues for hours or days after an ischemic insult to the brain.
- Hypotension and hypoperfusion should be avoided by maintaining MAP > 65 mm Hg and CPP of 50–70 mm Hg.
  - Normoxia or mild hyperoxia, with  $P_{aO_2}$  of 80–120 mm Hg and oxyhemoglobin saturations in the high 90s, should be maintained. Hypoxia and significant hyperoxia should be avoided.
- ICP elevation can further exacerbate ischemic brain injury. Initial management should include optimizing patient positioning while providing adequate analgesia and sedation. Management should then be escalated in a stepwise fashion to include hypertonic therapy, deep sedation with barbiturates, hypothermia, and surgery as needed.
- Hyperventilation decreases cerebral blood flow and should be avoided by targeting a  $P_{aCO_2}$  of 35–40 mm Hg. In the event of life-threatening cerebral herniation or significant ICP elevation, therapeutic hyperventilation is appropriate only as a short-term intervention bridging to more definitive therapy (ie, craniectomy).
- Hyperglycemia worsens neurologic outcome. Subcutaneous or IV insulin should be used to maintain a glucose level <180 mg/dL.
- When present, seizures should be promptly aborted using IV lorazepam, followed by treatment with IV phenytoin, valproic acid, or levetiracetam, with an initial 20-mg/kg loading dose. The prophylactic administration of antiepileptic drugs is not recommended, except for 7 days immediately following TBI. Levetiracetam, 500 mg bid, is a preferred agent.
- Fever is an important mediator of secondary brain injury and all temperatures >38°C should be treated promptly with acetaminophen and surface cooling.
- Comatose survivors of out-of-hospital cardiac arrest should be rapidly cooled in the ED, maintained at a constant target of 33°–36°C in an ICU setting for 24 hours after resuscitation, and receive targeted temperature management to prevent hyperthermia after this period.

## CHAPTER 7: QUESTIONS AND ANSWERS

**7.1.** To maximize cerebral blood flow, a patient with a normal intracranial pressure who is undergoing resuscitation should be ventilated to maintain a partial pressure of carbon dioxide ( $P_{aCO_2}$ ) within what range?

- A. 20 to 25 mm Hg
- B. 25 to 30 mm Hg
- C. 30 to 35 mm Hg
- D. 35 to 40 mm Hg
- E. 40 to 45 mm Hg

**Answer: D.** Carbon dioxide is a potent vasoactive agent, and lowering of the  $P_{aCO_2}$  by hyperventilation results in rapid reduction of cerebral blood flow (CBF). Because reductions in CBF reduce total cerebral blood volume, hyperventilation may transiently abort brainstem herniation in the presence of critically elevated intracranial pressure (ICP) until osmotherapy or ventriculostomy can be initiated. When ICP is not elevated, however, the vasoconstriction and increased cerebrovascular resistance (CVR) caused by hyperventilation can cause potentially dangerous reductions in CBF. In general, ventilation to maintain a  $P_{aCO_2}$  between 35 and 40 mm Hg is safe and appropriate.

**7.2.** True or false? Induced hypothermia for comatose survivors of ventricular fibrillation is a class 1A recommendation in the 2010 American Heart Association Emergency Cardiac Care/Advanced Cardiac Life Support Guidelines.

**Answer: True.**

**7.3.** Select the best answer. Which of the following statements is false?

- A. Early magnetic resonance imaging (MRI) and serum biomarkers have a clearly established role in determining the prognosis of patients within 48 hours after cardiac arrest.

**B.** In a study from the Resuscitation Outcomes Consortium, median survival to hospital discharge among all patients with emergency medical services (EMS) responses for cardiac arrest was 8.4%.

**C.** In cardiac arrest patients who survive to hospital admission, 14% to 55% have good long-term outcomes.

**D.** The vast majority of 1-year survivors of cardiac arrest are neurologically intact.

**Answer: Statement A is false.** The role of early imaging, neurophysiologic testing, and serum biomarkers in predicting outcome has not yet been clearly established at any time point, especially not within 48 hours.

**7.4.** True or false? A patient with return of spontaneous circulation after 15 minutes of cardiac arrest has likely already suffered substantial neuronal cell death.

**Answer: False.** Although a cascade of cellular pathways will have been triggered, the resulting neuronal cell death is usually delayed by hours or days.

**7.5.** Select the best answer. Which of the following is associated with worse neurologic outcomes in comatose survivors of cardiac arrest?

- A. All of these
- B. Hyperthermia
- C. Hypotension
- D. Hypoxia
- E. Only hypotension and hyperthermia

**Answer: Statement A is the best answer.** Hypotension, hypoxia, and hyperthermia (as well as hyperglycemia and seizures) are all associated with worse neurologic outcomes in comatose survivors of cardiac arrest.

## KEY CONCEPTS

- CPR quality is critical to successful resuscitation from cardiac arrest. Important benchmarks of quality CPR include compression rate between 100 and 120 compressions/min, compression depth of 5 to 6 cm, chest compression fraction of 80% or more, full chest recoil, and ventilation rate of 10 breaths/min.
- Restoration of adequate cardiac function is the defining factor of ROSC. Restoration of good neurologic function is the defining factor of successful resuscitation.
- Resuscitation of a cardiac arrest victim does not end with ROSC. Rapid diagnosis and proper management of the pathologic conditions that precipitated and resulted from the arrest, as well as goal-directed post-cardiac arrest care, can improve outcome.
- Immediate PCI is indicated in patients with demonstrated ST segment elevation MI following ROSC without regard to neurological status.
- Hypothermic targeted temperature management (32°–36° C [89.6°–96.8° F] for 24 hours) is the first and only post-ROSC intervention that has been shown to improve survival and functional outcome of comatose cardiac arrest survivors.

## CHAPTER 8: QUESTIONS &amp; ANSWERS

- 8.1. Which of the following statements regarding the epidemiology of out-of-hospital cardiac arrest is true?
- Most patients surviving to hospital discharge will have persistent neurologic deficits.
  - Of patients successfully resuscitated and admitted to the hospital, 75% will survive to hospital discharge.
  - Return of spontaneous circulation with subsequent hospital admission occurs in less than 3% of cases.
  - Ventricular fibrillation is estimated to be the initial rhythm in more than 50% of all cases.
  - With the application of therapeutic hypothermia, up to 50% of successfully resuscitated patients may survive to hospital discharge with return to prearrest function.

**Answer: E.** It is estimated that 176,000 patients are treated for out-of-hospital cardiac arrest each year in the United States. The proportion of emergency medical services (EMS)-treated cardiac arrest patients with an initial rhythm of ventricular fibrillation (VF) has declined over time to 20% in recent US studies. There is tremendous variability in survival to hospital discharge after EMS-treated cardiac arrest, ranging from 3% to 16.7%. Recent US data have indicated an average survival rate to hospital discharge of 11%. Of patients surviving to hospital discharge, independent of neurologic status on presentation, 78% have good neurologic function.

- 8.2. A 75-year-old man presents with return of spontaneous circulation (ROSC) after 2 minutes of VF and successful defibrillation by EMS. The patient is unresponsive to verbal and painful stimuli. Vital signs on arrival are pulse, 120 beats/min, blood pressure, 130/70 mm Hg, respiratory rate, 10 breaths/min, temperature, 36° C (96.8° F), and oxygen saturation, 94%. The patient has intravenous access. The next most appropriate examination or procedure is:
- Anteroposterior (AP) chest radiograph
  - Arterial blood gas (ABG)
  - Comprehensive neurologic examination
  - Electrocardiography
  - Oxygen via nonrebreather mask

**Answer: D.** Acute coronary syndrome is a common cause of out-of-hospital cardiac arrest. Electrocardiography should be performed as soon as possible after ROSC to evaluate for ST segment elevation. Because it is impossible to determine survival or neurologic status in the immediate postarrest period, ST segment elevation myocardial infarction (STEMI) should be treated aggressively with percutaneous coronary intervention (PCI) independently of coma or other laboratory values such as those provided on ABG analysis. Oxygen saturations above 94% are adequate for tissue perfusion, and hyperoxia may be harmful. AP chest radiographs may be important to evaluate ventilatory status if the patient is unstable.

- 8.3. Which chest compression/ventilation ratio is recommended during adult resuscitation efforts performed by health care professionals before placement of an advanced airway?
- 10 1
  - 20 1
  - 20 2
  - 30 2
  - None. Evidence has shown that chest compression-only cardiopulmonary resuscitation (CPR) is the most effective for health care providers.

**Answer: D.** A 30 2 compression/ventilation ratio is currently recommended for health care professionals in all adult resuscitation scenarios. Although recent evidence has suggested that chest compression-only CPR is effective when performed by bystanders in the out-of-hospital setting, there is inadequate evidence to recommend this as an alternative strategy for health care professionals, except when inadequate personnel are present to provide compressions, ventilation, and other resuscitative activities.

- 8.4. Which of the following statements regarding hypothermic targeted temperature management in comatose survivors of cardiac arrest is true?
- Gradual rewarming should occur over 4 hours.
  - Pregnancy is an absolute contraindication.
  - Prolonged pharmacologically induced paralysis is often required to control shivering.
  - Target core body temperature should be 32° to 36° C.
  - To achieve benefit, the target temperature must be reached in less than 30 minutes.

**Answer: D.** Induction of prolonged HTTM in comatose survivors of cardiac arrest has been shown to improve survival and functional outcome. A target temperature in the range of 32° to 36° C (89.6°–96.8° F) should be selected and maintained. The time to achieve this temperature has not been clearly defined, and it has been suggested that there is a broad therapeutic window. In the studies showing a benefit, maintenance of hypothermia occurred for 12 to 24 hours, followed by gradual rewarming over 12 to 24 hours. There are no absolute contraindications to induced hypothermia after arrest. Shivering, which inhibits cooling, can be prevented with sedation and pharmacologic paralysis. However, prolonged paralysis should be avoided because of the risk of unrecognized seizure activity in post-cardiac arrest patients.

- 8.5. For end-tidal pressure of carbon dioxide (PETCO<sub>2</sub>) to be a reliable indicator of cardiac output during cardiac arrest., which of the following must be present?
- A. Mechanical chest compression must be performed.
  - B. The patient must be in asystole.
  - C. Patient must be normothermic
  - D. The patient must have an endotracheal tube and relatively constant minute ventilation.
  - E. Vasopressor therapy cannot be used.

**Answer: D.** Although PETCO<sub>2</sub> will change in direct relationship to cardiac output, alterations in minute ventilation will concentrate or dilute the fixed amount of expired CO<sub>2</sub>, influencing the PETCO<sub>2</sub> measured independently of cardiac output. Therefore, for PETCO<sub>2</sub> to be a reliable indicator of cardiac output, minute ventilation must be held relatively constant. In addition, all studies demonstrating the relationship between PETCO<sub>2</sub> and cardiac output have been performed with an endotracheal tube in place. The relationship of PETCO<sub>2</sub> and cardiac output during CPR is not dependent on rhythm, mechanisms of chest compressions, or temperature. High-dose vasopressor therapy can cause a decreased in cardiac output during CPR, despite increased myocardial blood flow, which results in a decreased PETCO<sub>2</sub>.

## KEY CONCEPTS

- Younger adults with fever usually have benign self-limited disease, with low mortality. The challenge in this group is to identify the rare meningitis or septic condition when confronted with a predominance of self-limited viral and focal bacterial illness.
- For older patients, immunosuppressed patients, or those with chronic disease, fever indicates a high risk for serious disease. Temperature elevation may be minimal in these patients, who often are unable to mount a significant febrile response to serious infection. Bacterial infection is the most common cause of fever in these patients. Three body systems—the respiratory tract, urinary tract, and skin and soft tissue—are the target for more than 80% of these infections.
- Atypical symptoms of illness are common in older febrile patients. Altered mental status, difficulty with ambulation, frequent falls, and general functional decline may be the only signs of serious infection in older patients.
- The white blood cell count is not a discriminatory test for patients with fever, may incorrectly indicate serious infection when none is present, or may be normal in the presence of life-threatening infection.
- In febrile patients with serious signs and symptoms, early empirical antibiotic therapy is often appropriate. The choice of antibiotics is based on the likely cause of the fever as well as concomitant conditions, such as absolute neutropenia and end-stage renal disease.

## CHAPTER 9: QUESTIONS AND ANSWERS

9.1. Which three body systems are the target of more than 80% of bacterial infections in patients older than 65 years?

- Central nervous system, respiratory system, genitourinary system
- Central nervous system, respiratory system, skin and soft tissue
- Central nervous system, urinary system, skin and soft tissue
- Respiratory system, gastrointestinal system, genitourinary system
- Respiratory system, genitourinary system, skin and soft tissue

**Answer: E.** Patients older than 65 years who present with fever represent a group at high risk for serious disease. Morbidity and mortality in this group are significant. Between 70% and 90% are hospitalized, and 7% to 9% die within 1 month of admission. Infection is the most common cause of fever in these patients, and most of these infections are bacterial in nature. More than 80% of these infections originate from the respiratory system, genitourinary system, and skin and soft tissue.

9.2. A 65-year-old man presents after “briefly collapsing” at a nearby bus stop. On arrival, he is confused, opens his eyes spontaneously, and follows simple commands. A medical information card found in his wallet reveals a history of hypertension and gout. Vital signs reveal a blood pressure of 95/50 mm Hg, heart rate of 95 beats/min, respiratory rate of 24 breaths/min, temperature of 41.5°C, and arterial oxygen saturation (SaO<sub>2</sub>) of 95%. His finger-stick glucose level is normal. Pertinent physical examination findings include pallor, dry mucous membranes, Glasgow Coma Score (GCS) of 14, and ataxia. An intravenous bolus of normal saline is started. Which of the following is the most appropriate next step in the management of this patient?

- Administer broad-spectrum antibiotics.
- Mist the patient with water and place him in front of a fan.
- Obtain a head CT scan.
- Obtain an electrocardiogram.
- Perform a lumbar puncture.

**Answer: B.** In terms of initial resuscitative efforts, the most significant finding in this patient is a temperature of 41.5°C. Almost all cases of temperatures higher than 41.0°C (107°F) are due to hyperthermia rather than to fever. Sustained temperatures higher than 41.0°C (106°F) are rare but can be damaging to neural tissue and require rapid, aggressive, cooling measures, such as misting the patient with tepid water and placing him or her in front of a fan, immersion in cool water, or application of cooling blankets. Each of the other four options could potentially be performed

during this patient’s stay in the ED; however, the immediate focus is on temperature reduction.

9.3. Of the cases of functional decline in nursing home patients, 75% are due to which of the following?

- Congestive heart failure
- Coronary artery disease
- Dementia
- Infection
- Traumatic injuries secondary to falls

**Answer: D.** Of the cases of functional decline (eg, difficulty ambulating, anorexia, decreased activity, new urinary incontinence) in nursing home patients, 75% are due to infection.

9.4. An 85-year-old man is brought to the ED by his daughter, who says that he has had a fever and has been eating less than normal for 2 days. The patient has a history of hypertension and severe dementia. He can provide no useful information. His present temperature was recorded by the triage nurse to be 38.5°C (101°F). The remainder of his vital signs are within normal limits. The only abnormal findings on physical examination are slightly dry mucous membranes, confusion, and poor social interaction. The daughter confirms his mental status to be at baseline.

Which of the following are the two most important ancillary tests to perform in this patient?

- Blood culture and urine culture
- Urinalysis and chest radiography
- Urinalysis and white blood cell count
- White blood cell count and chest radiography
- White blood cell count and urine culture

**Answer: B.** The two most important ancillary tests in the evaluation of fever in the adult patient, and especially in older patients, who frequently have atypical presentations, are urinalysis and chest radiography. Chest radiographs are often helpful in the diagnosis of pulmonary infection but may be difficult to interpret in the patient with chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), or other chronic lung disease. Urinalysis, although not foolproof, is highly accurate for urinary tract infection, especially in men. Although the white blood cell count is almost universally used in the evaluation of febrile patients, it lacks sufficient sensitivity and specificity to be of discriminatory value. Cultures are ordered in selected patients; however, the delay in obtaining results precludes any influence in emergency evaluation and treatment. Other tests that have relevance in select patients with fever include Gram staining, cerebrospinal fluid (CSF) analysis, thyroid function studies, ultrasonography, and computed tomography (CT) of the abdomen or head.

## CHAPTER 10: QUESTIONS AND ANSWERS

- 10.1.** A 65-year-old man with a history of atrial fibrillation, on warfarin, with a supratherapeutic international normalized ratio (INR) of 4, presents with sudden onset right leg weakness and back pain. On examination, he is tachycardic to 108 beats/min and has 3/5 weakness to the right hip flexors and extensors, knee flexors and extensors, as well as ankle dorsiflexion and great toe extension. However, ankle plantar flexion is preserved. His knee reflexes are absent, but Achilles reflexes are normal. He has a normal Babinski reflex and no spasticity. He has sensory deficits throughout the anterior and posterior parts of his proximal leg as well as the anterior lower leg and dorsum of the foot. His posterior lower leg and plantar surface, however, have normal sensation. Rectal tone is normal, and there is no urinary retention. His most likely diagnosis is:
- Anterior cord syndrome from epidural hematoma
  - Cauda equina syndrome
  - Guillain-Barré syndrome
  - Hemorrhagic anterior cerebral artery (ACA) distribution stroke
  - Retroperitoneal hematoma with lumbar plexopathy

**Answer: E.** This patient has a spontaneous retroperitoneal hematoma compressing the lumbar nerve plexus.

- 10.2.** A 45-year-old man has had gradual onset of progressive weakness to his face and trouble swallowing for 2 days. On examination, he has bilateral ptosis with dilated, poorly reactive pupils, bilateral upper and lower facial muscle weakness, poor soft palate rise, and slurred speech. His oral mucosa is dry. Arms and legs have 5/5 strength. He has no sensory deficits. He has a palpable distended bladder. His symptoms have not abated since onset, and they are getting worse. The most likely diagnosis is:
- Brainstem stroke
  - Botulism
  - Muscular dystrophy
  - Myasthenia gravis
  - Organophosphate poisoning

**Answer: B.** This patient has acute onset of progressive neuromuscular junction weakness. He has autonomic findings of abnormal pupil response to light, dry oral mucosa from decreased salivary production, and a distended bladder. These imply that his problem is with the release of acetylcholine (ACh) rather than the nicotinic receptor. The latter would not have autonomic findings. The most appropriate cause of acute onset, progressive impairment in the release of ACh, as listed in the choices, is botulism.

- 10.3.** A 23-year-old woman presented with the sudden onset of weakness to her face, arm, and leg 2 hours ago. On examination, she has weakness to her upper and lower face on the left. She cannot abduct her left eye. She has 3/5 strength to her upper and lower extremities on her right side. She has a right pronator drift and an upgoing toe on the right. Sensation is decreased in her right upper and lower extremities as well. There is no aphasia, neglect, or visual field deficit. The most likely diagnosis is:
- Midbrain stroke because of cardioembolic stroke
  - Middle cerebral artery (MCA) distribution stroke

- Multiple sclerosis
- Myasthenia gravis
- Pons stroke because of vertebral dissection

**Answer: E.** This patient has acute onset of crossed face and extremity weakness, with upper motor neuron (UMN) signs in the extremities. Both upper and lower extremities are affected, which makes a corticospinal tract (CST) lesion more likely than a cerebral cortex lesion. Her left-sided facial weakness is representative of a peripheral cranial nerve (CN) VII that is actually due to infarction of the CN VII nucleus in the brainstem. The CN VI deficit on that side is due to proximity of this nucleus as well. The CST runs just anterior to these nuclei within the brainstem. These CN nuclei lie in the pons.

- 10.4.** A 21-year-old man awoke this morning with weakness to his right hand and right foot. He admits to drinking heavily the night before and falling asleep on the floor. On examination, he appears well, with weakness to right wrist extension and thumb extension, as well as sensory deficits over the dorsal surface of his hand and first and third digits. He also has weakness to ankle dorsiflexion and great toe extension on the right. He has sensory deficits over the anterior lower leg and the dorsum of his foot. Biceps and ankle reflexes are intact, he has no pronator drift, and his toes are downgoing. His most likely diagnosis is:
- Brainstem stroke
  - Brown-Séquard syndrome
  - Compressive neuropathy
  - MCA distribution stroke
  - Polyradiculopathy secondary to disk disease

**Answer: C.** He has radial nerve and peroneal nerve palsies because of compression while lying passed out on the floor for an unspecified time.

- 10.5.** A 70-year-old man has had trouble swallowing and progressive weakness of his hands over the past 2 months. On examination, his speech is slurred, his voice is nasal, and he has fasciculations to his face, tongue, and over his pectoralis muscles and deltoids bilaterally. He has 4/5 strength to shoulders, biceps, triceps, and hand grip bilaterally. Stiffness to extension is present at both elbows. He has bilateral pronator drift and 3+ biceps reflexes. He tends to smile inappropriately. He has no sensory symptoms. The most likely diagnosis is:
- Amyotrophic lateral sclerosis (ALS)
  - Brainstem stroke
  - Chronic demyelinating polyneuropathy
  - Parkinsonism
  - Polymyositis

**Answer: A.** This patient has lower motor neuron (LMN) signs (fasciculations) and UMN signs (pronator drift and increased reflexes) in similar distribution. The combination of upper and lower motor neuron involvement make ALS the leading diagnosis among those listed. His dysphagia and inappropriate smiling are due to a release of the medulla from upper motor neuron regulation.



## KEY CONCEPTS

- Cyanosis occurs as a result of an absolute amount of desaturated hemoglobin rather than a percentage; anemic patients exhibit cyanosis at a lower  $P_{aO_2}$  than those with normal hemoglobin levels.
- Central cyanosis is due to a shunting of unsaturated (venous) hemoglobin to the arterial circulation, whereas peripheral cyanosis is due to vasoconstriction or slow flow of normally oxygenated hemoglobin to the peripheral tissues.
- Methemoglobin has a chocolate brown color, even when exposed to room air.
- The pulse oximeter for patients with methemoglobinemia typically reads 85%, regardless of the  $P_{aO_2}$  or  $S_{aO_2}$ .
- Congenital heart disease is a prime diagnostic consideration in all infants presenting with cyanosis.
- Toxic exposures, particularly to aniline dyes and local anesthetics, are considered in acute cyanosis.
- Sulfhemoglobin is reported as methemoglobin on CO-oximetry; patients with methemoglobinemia on CO-oximetry who do not respond to methylene blue treatment likely have sulfhemoglobinemia.
- Clinical improvement of the cyanotic patient with supplemental oxygen suggests a diffusion impairment as the cause.
- All patients with a first episode of cyanosis or an uncertain cause require hospitalization.

## CHAPTER 11: QUESTIONS AND ANSWERS

- 11.1. Which of the following statements regarding methemoglobin is true?
- Methemoglobin begins to produce cyanosis when its concentration reaches 25% of total hemoglobin.
  - Methemoglobin changes from dark purple to light red when exposed to room air.
  - Methemoglobin normally accounts for 5% of total hemoglobin.
  - Methylene blue accelerates the reduction of methemoglobin to hemoglobin.
  - The primary method of reducing methemoglobin to hemoglobin is glucose-6-phosphate dehydrogenase (G6PD) dependent.

**Answer: D.** Methemoglobin normally accounts for less than 1% of total hemoglobin. Cyanosis results when MORE than 10% to 15% of the total hemoglobin is methemoglobin, which has a dark purple-brown color, even when exposed to room air. Methemoglobin is reduced to ferrous hemoglobin primarily by reduced nicotinamide adenine dinucleotide (NADH) cytochrome b5 reductase, an enzyme system present in red blood cells. A secondary reduced nicotinamide adenine dinucleotide phosphate (NADPH) dependent system uses glutathione production and G6PD to reduce methemoglobin to hemoglobin. This secondary pathway normally plays a minor role but is accelerated by methylene blue.

- 11.2. Which of the following conditions produces peripheral cyanosis?
- Diaphragmatic hernia
  - High altitude >8000 ft
  - Hypovolemia
  - Impaired oxygen diffusion
  - Pulmonary hypertension

**Answer: C.** Peripheral cyanosis is secondary to vasoconstriction and a slow flow of normally oxygenated hemoglobin in arterial blood, allowing for greater oxygen extraction by the tissues. Hypovolemia causes a low-flow state that can produce peripheral cyanosis. The remaining options would cause a central cyanosis secondary to decreased arterial oxygen saturation.

- 11.3. Which of the following conditions produces central cyanosis?
- Hypothermia
  - Raynaud's phenomenon
  - Shock
  - Venous insufficiency
  - Ventricular septal defect

**Answer: E.** Central cyanosis is caused by decreased arterial oxygen saturation, shunting of venous unsaturated hemoglobin into the arterial circulation, or the presence of abnormal hemoglobin. A ventricular septal defect causes shunting of deoxygenated blood

from the right side of the heart to the left, with resultant decreased arterial oxygen saturation and central cyanosis. The remaining options would cause a peripheral cyanosis.

- 11.4. In the cyanotic patient, clinical improvement with supplemental oxygen is most suggestive of which of the following underlying processes?
- Arterial emboli
  - Congenital heart disease with right-to-left shunting
  - Hyperventilation
  - Impaired oxygen diffusion
  - Ventilation-perfusion mismatching

**Answer: D.** Clinical improvement with oxygen suggests diffusion impairment. Patients who do not respond to oxygen are more likely to have ventilation-perfusion ratio abnormalities, such as shunting from pulmonary consolidation or congenital heart disease with right-to-left shunting. Arterial emboli will be affected by supplemental oxygen.

- 11.5. Which of the following statements regarding polycythemia is correct?
- Polycythemia is defined as an elevated hemoglobin level.
  - Polycythemia vera may result from an increase in the erythropoietin level.
  - Patients may present with hyperviscosity syndrome.
  - Relative polycythemia occurs from high-altitude exposures.
  - Secondary polycythemia is often due to dehydration.

**Answer: C.** Polycythemia is defined as an elevated red blood cell (RBC) mass resulting from one of three causes. Polycythemia vera is a disorder of bone marrow stem cells with increased RBC mass, cyanosis, and splenomegaly. Patients may present with hyperviscosity syndrome. Secondary polycythemia occurs with an appropriate or inappropriate increase of erythropoietin, a physiologic response to chronic hypoxemia, cyanotic congenital heart disease, cigarette smoking, or high-altitude exposures. Relative polycythemia is an increased RBC mass, often resulting from dehydration or reduced plasma volumes.

- 11.6. Soon after receiving topical upper airway anesthesia with benzocaine, a patient becomes tachypneic and complains of chest pain. The patient is noted to be cyanotic. Supportive measures are initiated, and CO-oximetry reveals a methemoglobin level of 40%. Which of the following should be administered?
- Benadryl
  - Hyperbaric oxygen
  - Methylene blue
  - Nitroglycerin
  - Thrombolytics



**Answer: C.** Local anesthetics such as benzocaine, lidocaine, and prilocaine can cause an acquired methemoglobinemia. Urgent treatment with oxygen and methylene blue is indicated in such patients, especially when accompanied by symptomatic hypoxia (eg, dysrhythmias, angina, respiratory distress, seizures, coma) and methemoglobin levels greater than 30%.

**11.7.** An otherwise healthy 35-year-old woman presents with headache, mild shortness of breath, and central cyanosis. She is currently taking trimethoprim-sulfamethoxazole and phenazopyridine for a urinary tract infection. She does not improve with supplemental oxygen. Her chest radiograph is normal. CO-oximetry shows a methemoglobin level of 28%. Her medications are withheld. The patient shows no improvement after 2 mg/kg of methylene blue is administered. Ongoing management should include which of the following treatments?

- A. Calcium channel blockers
- B. Hydroxycobalamin
- C. Phlebotomy
- D. Sodium thiosulfate
- E. Supportive care

**Answer: E.** This patient has likely has sulfhemoglobinemia, a rare complication of the medication phenazopyridine (Pyridium).

Standard CO-oximetry will report sulfhemoglobin as methemoglobin. Both sulfamethoxazole and phenazopyridine can also cause methemoglobinemia. Patients with an elevated methemoglobin level and no response to methylene blue likely have sulfhemoglobinemia, which is less severe than methemoglobinemia and only requires supportive care. Phlebotomy is the treatment for polycythemia. Sodium thiosulfate and hydroxycobalamin are both used to treat cyanide toxicity, and calcium channel blockers may be used to treat peripheral cyanosis resulting from vasospasm (Raynaud's phenomenon).

**11.8.** Acute treatment for symptomatic hyperviscosity syndrome includes which of the following?

- D. Heparin
- E. Methylene blue
- C. Nifedipine
- A. Phlebotomy
- B. Warm compresses

**Answer: A.** Patients with polycythemia and other conditions that increase the viscosity of blood may present with symptomatic hyperviscosity syndrome. Acute therapy for these patients includes phlebotomy and volume expansion with isotonic crystalloid. The goal of therapy is a normal hematocrit. Long-term therapy is focused on the underlying cause, and patients typically require referral to a hematologist.

## KEY CONCEPTS

1. The pathophysiology of syncope is dysfunction of both cerebral hemispheres or the brainstem (reticular activating system), usually from acute hypoperfusion. Reduced blood flow may be regional (cerebral vasoconstriction) or systemic (hypotension). Loss of consciousness results in loss of postural tone, with the resulting syncopal episode.
2. Presyncope (near-syncope) or lightheadedness are less severe symptoms and may be considered on a continuum with syncope and share causes, mechanisms, and outcomes.
3. The potential causes of syncope are protean. The first differential diagnostic consideration is to distinguish syncope from other causes of an apparent sudden loss of consciousness, especially seizure and uncommon disorders such as cataplexy.
4. Most cases of syncope arise from benign causes, so the history is largely focused on identifying those cases caused by serious pathology. The past medical history, particularly cardiovascular disease and heart failure, is a key factor in determining future risk of morbidity and mortality.
5. The physical examination of syncope focuses primarily on the elements affecting the cardiovascular and neurologic systems.
6. The chief diagnostic adjunct in evaluating syncope is the 12-lead ECG. It should be obtained on nearly all patients. Studies suggest an overall diagnostic yield of 2% to 9%.
7. Routine hematologic, chemistry, urine, and imaging studies have limited usefulness in the evaluation of syncope and are generally not indicated unless directed by specific factors in the history or physical examination.
8. Disposition of syncope patients can be informed through identification of factors suggesting increased risk of short-term mortality. Predication rules and scoring systems have not yet been validated or shown to be superior to physician gestalt and should not be used alone.
9. Hospitalization is required for patients with chest pain, unexplained shortness of breath, history of congestive heart failure, significant valvular disease, or serious ECG findings. Admission is recommended for patients with factors indicating high-risk of short-term mortality.
10. Men younger than 45 years and women younger than 55 years and without worrisome symptoms, signs, or electrocardiographic findings are generally at very low risk for adverse outcome and can often be treated on an outpatient.

## CHAPTER 12: QUESTIONS AND ANSWERS

- 12.1. Which of the following statements regarding the epidemiology of syncope is true?
- A. Of athletes who die during exercise, 30% have had a prior episode of syncope.
  - B. People younger than 65 years account for 50% of all patients admitted for syncope from the emergency department.
  - C. Syncope in adolescents is typically secondary to significant pathology.
  - D. Syncope in the general population has a prevalence of approximately 1%.
  - E. Women have an increased risk of recurrence of syncope.

**Answer: A.** The prevalence of syncope in the general population is approximately 19%. This accounts for 0.8% of emergency department (ED) visits. Approximately 32% of these patients are admitted, and people aged 65 years or older account for 80% of such admissions. Recurrence of syncope may be as high as 50% and is not associated with age or gender. Benign causes of syncope predominate in adolescents and young adults. Approximately 30% of athletes who die during exercise, however, have had a prior episode of syncope as a sentinel event.

- 12.2. Syncope resulting from serious pathology is usually caused by which of the following?
- A. Cerebrovascular disease
  - B. Dysrhythmias and myocardial ischemia
  - C. Pulmonary embolism
  - D. Structural cardiac lesions
  - E. Toxic-metabolic abnormalities

**Answer: B.** The principal serious causes of syncope are dysrhythmias and myocardial ischemia. Cerebrovascular disease, principally subarachnoid hemorrhage, is less frequently encountered but equally serious. Toxic-metabolic abnormalities may induce syncope through alterations in blood pressure or cardiac rhythm. Structural cardiac lesions, such as critical aortic stenosis, and sudden interruption of right ventricular outflow by pulmonary embolism, can also cause sudden loss of consciousness.

- 12.3. Which of the following findings suggest that a patient presenting with syncope can be safely discharged from the ED?
- A. Anemia
  - B. History of congestive heart failure (CHF)
  - C. Hypotension
  - D. Normal ECG findings
  - E. Shortness of breath

**Answer: D.** A normal electrocardiogram in a patient without other significant risk factors (eg, advanced age, preexisting congestive heart failure, shortness of breath) may be considered for outpatient disposition.

## KEY CONCEPTS

- Consciousness consists of arousal (subcortical) and awareness (cortical).
- Damage to the dorsal brainstem, thalamus, or axonal projections to the cortex, or extensive injury to bilateral cortices, may result in depressed consciousness or coma.
- Toxic, metabolic, and infectious causes of coma make up 65% of cases; of these, toxins are the most common. Structural brain diseases make up most of the remaining 35% of cases.
- An abrupt onset of coma suggests a stroke, seizure, cardiac event, or poisoning.
- A patient with depressed consciousness is unlikely to provide a reliable history. Historical information should be elicited from other available sources, such as EMS and family.
- The neurologic examination includes an evaluation of level of consciousness, cranial nerves, brainstem reflexes, and motor responses.
- Pinpoint pupils may represent a pontine infarct or intoxication from opioids, clonidine, or cholinergic medications.
- Hypoglycemia and hypoxia are two easily identified and reversible causes of coma.
- An empirical trial of naloxone will lead to rapid reversal of opioid toxicity and other medication overdoses.
- Nonconvulsive status epilepticus should be suspected in cases of coma of undetermined cause and is diagnosed by EEG.
- Most patients with coma will require intensive care. Transfer patients if the cause of coma is not treatable in the current facility (eg, structural lesion requiring neurosurgery).

## CHAPTER 13: QUESTIONS &amp; ANSWERS

**13-1.** In infants, what is the most common cause of a depressed level of consciousness?

- A. Accidental toxic ingestion
- B. Hypoxia
- C. Infection
- D. Inborn errors of metabolism
- E. Physical abuse

**Answer: C.** Causes of a depressed level of consciousness vary with patient age. In infants, infectious causes of depressed consciousness are most common; however, trauma secondary to physical abuse and metabolic derangements from inborn errors of metabolism can be seen. Accidental toxic ingestions are often seen in younger children but are very uncommon in infants. Young adults and adolescents are more likely to present after recreational drug use or trauma. Finally, older adults are particularly vulnerable to infectious causes, medication changes, and alterations in their living environments.

**13-2.** What Glasgow Coma Scale (GCS) score would be given to an adult patient who opens the eyes to painful stimuli, speaks in an incomprehensible manner, and withdraws to pain?

- A. 6
- B. 7
- C. 8
- D. 9
- E. 10

**Answer: C.** Using the GCS, this patient would receive 2 points for eye opening to pain, 2 points for verbal response consisting of incomprehensible words, and 4 points for withdrawing to painful stimuli.

**13-3.** What GCS score would be given to a pediatric patient who opens the eyes and flexes the extremities to painful stimuli and who is persistently irritable?

- A. 6
- B. 7
- C. 8
- D. 9
- E. 10

**Answer: C.** Using the GCS, this patient would receive 2 points for eye opening to pain, 3 points for persistently being irritable, and 3 points for flexion to painful stimuli.

**13-4.** Awareness of one's self or surroundings defines which of the following?

- A. Cognition
- B. Consciousness
- C. Judgment
- D. Memory
- E. Orientation

**Answer: B.** Consciousness is defined as the awareness of one's self or surroundings; it is made up of arousal and cognition. Cognition is the combination of orientation, the accurate perception of what is experienced, judgment, the ability to process input data to generate more meaningful information, and memory, the ability to store and retrieve information.

## KEY CONCEPTS

- Confusion is a symptom, not a diagnosis.
- Focal cortical dysfunction, such as from tumor or stroke, typically does not cause confusion.
- Any underlying clinical process that disrupts optimal central nervous system (CNS) functioning can result in confusion.
- Emergent causes of confusion that need immediate detection and treatment include hypoglycemia, hypoxemia, hypotension, sepsis, and toxic ingestions.
- Assessment of attention is fundamental for the assessment of patients with confusion.
- The confusion assessment method (CAM) is a validated tool for identifying patient with delirium.
- Delirium often goes unrecognized unless a structured assessment tool is used.
- Midazolam is useful for managing undifferentiated agitation while the diagnostic evaluation is in progress.

## CHAPTER 14: QUESTIONS &amp; ANSWERS

- 14.1.** A 70-year-old man with a chief complaint of confusion is brought to the emergency department by his family. Which of the following initial assessments should be included?
- All of these
  - Blood pressure
  - Pulse oximetry
  - Rapid bedside glucose testing
  - Temperature

**Answer: A.** Confusion may result from shock states, hypoglycemia, and hypoxia. Evaluation for these conditions is a priority. Confusion is a symptom rather than a medical condition, and reversible remedial causes should be investigated.

- 14.2.** A variety of screening tests may aid in the detection of confusion. Which of the following conditions may inhibit performance of these tests?
- Attention impairment
  - Cortical blindness
  - Disorientation
  - Hemiparesis
  - Long-term memory impairment

**Answer: A.** Deficiency in attention span will impair performance of all tests of cognitive performance. If the patient cannot attend to simple tasks, more detailed testing is not possible.

- 14.3.** A 30-year-old patient is brought to the emergency department for evaluation of odd behavior. Which of the following characteristics might suggest a psychiatric cause for the behavior?
- Auditory hallucinations
  - Disorientation
  - Fever
  - Olfactory hallucinations
  - Visual hallucinations

**Answer: A.** Auditory hallucinations are common in psychiatric illness. If hallucinations are present in organic causes of delirium, they are usually visual, tactile, or olfactory. Orientation is generally preserved with primary psychiatric disorders unless psychosis or severe impairment is present.

- 14.4.** Postictal confusion is common in patients with seizures, but if improvement in consciousness does not occur within 20 to 30 minutes after seizure cessation, which of the following conditions should be considered?
- all of these
  - electrolyte abnormalities
  - head injury
  - hypoglycemia
  - nonconvulsive or subtle status epilepticus

**Answer: A.** For a patient with a generalized convulsive seizure, termination of the seizure activity should be followed by improvement of mental status within a short period of time. For the patient with persistently altered consciousness or prolonged confusion, consider causes of provoked seizures with prolonged altered mental status or persistence of subtle seizures.

## KEY CONCEPTS

- The differentiation between seizures and other causes of altered mentation or abnormal motor activity is not always straightforward and may require synthesizing the history, physical examination, laboratory results, and imaging data.
- Beginning in the out-of-hospital setting, patients with possible seizure activity should be protected from injury and assessed for hypoglycemia.
- Status epilepticus is defined as seizures lasting more than 5 minutes or repeat seizures while still postictal.
- Primary abortive therapy for seizures in the ED setting includes lorazepam; if diazepam is used in status epilepticus, it should be immediately followed by a loading dose of phenytoin, fosphenytoin, or valproic acid.
- Neuroimaging is recommended for patients with seizures who have head trauma, persistently abnormal mental status, focal neurologic abnormality, or HIV infection.
- Nonconvulsive status epilepticus should be considered in patients with a prolonged postictal state or otherwise unexplained coma.
- Patients with a first-time seizure who have no known structural brain pathology, normal serum glucose and sodium levels, and normal neurologic examination can be discharged from the ED with appropriate outpatient follow-up.

## CHAPTER 15: QUESTIONS &amp; ANSWERS

15.1. Which of the following is a generalized seizure disorder characterized by lack of a postictal state?

- A. Atonic seizure disorder
- B. Clonic seizure disorder
- C. Myoclonic seizure disorder
- D. Temporal lobe epilepsy
- E. Tonic-clonic seizure disorder

**Answer: A.** Atonic seizure disorder, also known as atonic drop attack ictus, is notable among the generalized seizure disorders because of its lack of postictal state. Postictal states may be seen following tonic-clonic, clonic, and myoclonic seizures. Temporal lobe epilepsy is a focal, instead of generalized, seizure disorder.

15.2. What is the most common metabolic cause of seizure activity?

- A. Hypercalcemia
- B. Hyperglycemia
- C. Hypermagnesemia
- D. Hypocalcemia
- E. Hypoglycemia

**Answer: E.** Seizure activity secondary to metabolic derangements is most commonly caused by hypoglycemia. The only treatment required in this situation may be intravenous (IV) glucose. Prolonged seizure activity may also cause hypoglycemia so that the cause and effect relationship may sometimes be reversed, and further therapy may be required.

15.3. A 15-year-old girl is brought to the emergency department for evaluation of a recent seizure. While awaiting laboratory results, she begins to have further seizure activity. Which of the following is the optimal first-line agent to terminate her seizure activity?

- A. Fosphenytoin
- B. Lorazepam
- C. Phenobarbital
- D. Phenytoin
- E. Valproic acid

**Answer: B.** Benzodiazepines are the optimal first-line agents for stopping seizure activity in patients of all ages. Available agents include lorazepam, diazepam, and midazolam. Phenytoin is recommended as second-line therapy for adults with persistent seizure activity. The prodrug, fosphenytoin, can be administered more quickly, can be given intramuscularly, and has less of a tendency to cause hypotension. Second-line therapy for children is phenobarbital. Third-line therapy is pentobarbital, propofol, or a benzodiazepine infusion. Valproic acid should be considered for patients who are on chronic valproic therapy and whose levels are subtherapeutic.

15.4. A 24-year-old man is brought to the emergency department by emergency medical services (EMS). The patient's mother reports that she found her son seizing on the floor of her living room approximately 30 minutes before arrival at the hospital. Two months ago, the patient returned from Mexico, where he had been incarcerated for 6 months. The mother reports that during the past 2 months she has seen her son consistently take his seizure medicine and several other pills for a "bad lung infection" he got in Mexico. She cannot remember the names of any of the medications. Several doses of IV lorazepam have been administered, with no effect on the patient's seizure activity. Which of the following medications would be the most effective in aborting his seizure activity?

- A. Diazepam
- B. Magnesium sulfate
- C. Phenytoin
- D. Pyridoxine
- E. Valproic acid

**Answer: D.** Several historical clues in this scenario point to tuberculosis being the "bad lung infection" in this patient. In patients with seizures that are refractory to benzodiazepines, isoniazid (a common medication for tuberculosis) overdose is a possibility and should be considered. Pyridoxine is the only fully effective pharmacologic treatment for toxic isoniazid seizures, although benzodiazepines have been shown to suppress seizure activity in some cases.

15.5. A mother arrives with her 10-year-old daughter (41 kg) who has been seizing for at least 10 minutes. The patient has a history of epilepsy, and a home dose of rectal diazepam has been ineffective. The mother states that the child has been in her usual state of good health until the seizure began, and there has been no history of trauma. Which of the following is the most appropriate initial action?

- A. Administer 10 mg midazolam intramuscularly.
- B. Consult neurology to obtain a bedside electroencephalogram.
- C. Endotracheal intubation with vecuronium and etomidate.
- D. Establish vascular access and administer 2 mg of lorazepam.
- E. Obtain an immediate computed tomography scan of the head.

**Answer: A.** Early, aggressive benzodiazepine administration is associated with decreased morbidity and mortality in status epilepticus. Intramuscular midazolam is superior to intravenous lorazepam; in addition, the dose of lorazepam is inadequate. Endotracheal intubation may ultimately be required, but is a secondary priority; use of a long-acting neuromuscular blockade agent, such as vecuronium, should be avoided. Cranial computed tomography may or may not be needed in this patient, depending on the response to benzodiazepine therapy. Bedside electroencephalograms are most useful in diagnosing nonconvulsive status epilepticus.

- 15.6. Paramedics present with a 24-year-old woman with a history of epilepsy after a seizure. She is somnolent but easily arousable and oriented to self and year. Her vital signs are normal, there are no signs of trauma, and an empty expired bottle of phenytoin is found in her purse. Her prehospital finger stick blood glucose level is 163 mg/dL. Which of the following treatment options is most correct?
- A. Administer 20 mg/kg fosphenytoin intramuscularly and observe the patient until she returns to baseline.
  - B. Establish vascular access, and administer 4 mg lorazepam IV.
  - C. Establish vascular access, obtain a phenytoin level, and administer 1 to 2 mg lorazepam IV if the patient begins to seize.
  - D. Place the patient in a monitored setting, establish vascular access, and withhold diagnostic tests and treatments unless patient's condition changes.

**Answer: C.** Medication noncompliance is a frequent cause of seizures in adults with epilepsy. It is recommended to check phenytoin levels before administering additional drug. Because the patient is not in status epilepticus, a low dose of benzodiazepines can be considered for patients who begin to seize while undergoing a period of observation.

- 15.7. Which of the following is not part of the routine emergency department evaluation and treatment of a 21-year-old healthy woman with a first seizure?
- A. Discharge, with early outpatient neurology follow-up
  - B. Evaluation of serum electrolyte levels
  - C. Initiation of antiepileptic drug therapy.
  - D. Performance of cranial computed tomography

**Answer: C.** Adults presenting with a first seizure should undergo cranial computed tomography and evaluation of serum electrolyte and glucose levels because abnormalities would likely influence disposition while identifying potentially life-threatening conditions. For otherwise healthy adults with normal findings after evaluation, early outpatient follow-up can be considered. In some cases, initiation of antiepileptic drugs can be considered after a first seizure; however, this should be done in consultation with the neurologist responsible for outpatient follow-up.

- 15.8. Which of the following findings is uniformly reliable when trying to differentiate a seizure from a syncopal episode?
- A. Loss of bowel or bladder continence
  - B. None of these
  - C. Report of nonpurposeful rhythmic movements from bystanders
  - D. Tongue biting
  - E. Transient confusion after the event

**Answer: B.** Unfortunately, although all the findings listed are seen more commonly with seizures than with syncope, all can occur in patients with syncope. Atonic seizures, commonly called drop attacks, are not followed by a postictal state.



## KEY CONCEPTS

1. Associated neurologic complaints, such as imbalance, dysarthria, or numbness raise the likelihood of TIA or stroke as the cause of a patient's dizziness/vertigo.
2. Benign paroxysmal positional vertigo (BPPV) requires head movement to elicit symptoms. Consequently, the Hallpike test should *not* be performed if the patient is actively symptomatic during history taking (and the patient's head has not been recently moved) because such a history is inconsistent with BPPV.
3. When performing the Hallpike test, the head should be turned to the side 45 degrees prior to laying the patient back into the head-hanging position.
4. A positive Hallpike test should elicit upbeating nystagmus.
5. The Epley maneuver is used to treat posterior semicircular canal BPPV, which is the most common subtype of BPPV.
6. Central causes of nystagmus are more likely when the pattern of nystagmus is purely vertical, downbeating (fast phase beating toward the nose), non-fatigable, direction changing with gaze, or spontaneous pure torsional.
7. The presence of auditory symptoms suggests a peripheral cause of the vertigo.
8. Acute vestibular syndrome is diagnosed when dizziness develops acutely; is constant; is accompanied by nausea or vomiting, unsteady gait, nystagmus, and intolerance to head motion; and persists for longer than a day.
9. Neck injury can cause vertigo from vertebral artery dissection, resulting in posterior circulation ischemia.
10. Abnormal nystagmus is the cardinal sign of inner ear disease and the principal objective evidence of abnormal vestibular function.
11. *HINTS* (Head Impulse test, Nystagmus, Test of Skew) is a bedside oculomotor examination test that has been proposed as a way to differentiate central from peripheral vertigo in patients with a first ever onset of constant vertigo from acute vestibular syndrome.
12. Meclizine (Antivert) has a time of onset of approximately 1 hour.
13. Do not prescribe benzodiazepines to patients with vestibular neuritis or labyrinthitis who are discharged home. Such medications can interfere with the process of vestibular rehabilitation.

## CHAPTER 16: QUESTIONS &amp; ANSWERS

- 16.1. Which maneuver should be used to treat benign paroxysmal positional vertigo (BPPV) of the horizontal semicircular canal?
- A. Barbeque roll
  - B. Epley maneuver
  - C. Hallpike test
  - D. Head impulse test

**Answer: A.** The Epley maneuver is used to treat posterior canal BPPV. The Hallpike test is used to diagnose posterior canal BPPV. The head impulse test is used to diagnose vestibular neuritis and labyrinthitis. The supine roll test, in which the patient lies flat on the gurney and the head is turned to each side, is used to diagnose horizontal canal BPPV, whereas the barbeque roll maneuver is used to treat the horizontal variant of BPPV.

- 16.2. Which of the following examination findings requires further testing and/or consultation with a specialist?
- A. Direction changing nystagmus on change in head position
  - B. Direction changing nystagmus on change in lateral gaze
  - C. Positive head impulse test
  - D. Torsional upbeat nystagmus during Hallpike test

**Answer: B.** Direction changing nystagmus on change in gaze is concerning for a central cause of vertigo and makes up part of the HINTS test.

- 16.3. Internuclear ophthalmoplegia most often suggests a diagnosis of:
- A. Horizontal canal BPPV
  - B. Labyrinthitis
  - C. Multiple sclerosis
  - D. Vestibular neuritis

**Answer: C.** Internuclear ophthalmoplegia is diagnosed when, on eye movement, the adducting eye shows little to no movement while the abducting eye moves normally. In a vertigo patient, this finding is virtually pathognomonic for multiple sclerosis.

- 16.4. Which of the following is a central cause of vertigo?
- A. Labyrinthitis
  - B. Ménière's disease
  - C. Vertebrobasilar insufficiency
  - D. Vestibular neuritis

**Answer: C.** All the other causes are peripheral.

- 16.5. Continuous vertigo of what duration is used to define acute vestibular syndrome?
- A. 1 hour
  - B. 8 hours
  - C. 24 hours
  - D. 1 week

**Answer: C.** Acute vestibular syndrome has an arbitrary cutoff of continuous vertigo for at least 1 day in part to help differentiate acute vestibular syndrome from attacks of Ménière's disease or prolonged migrainous vertigo.

## KEY CONCEPTS

- When a patient with a known headache disorder presents with a change in the pattern of the headache, evaluate for potential serious causes.
- The physical examination in the headache patient focuses on cranial nerves (CNs) II, III, IV, and VI.
- Opioid medication is almost never the analgesic of choice for headache. Simple headache is treated with nonsteroidal analgesic medication, and specific antimigraine therapies are used for migraine.
- Most patients with headache do not require neuroimaging. When obtained, neuroimaging should be tailored to the specific elements of the differential diagnosis of concern.
- The differential diagnosis of sudden severe headache includes subarachnoid or other intracranial hemorrhage (ICH), cerebral venous thrombosis, and cervical artery dissection.
- In those patients for whom there is concern for subarachnoid hemorrhage (SAH), a normal head CT scan obtained using a high resolution scanner within 6 hours of onset is sufficient to rule out SAH. Patients outside this window require lumbar puncture (LP) to achieve appropriate sensitivity in the evaluation.
- Antibiotics should be given prior to LP being performed when bacterial meningitis is suspected.

## CHAPTER 17: QUESTIONS &amp; ANSWERS

- 17.1. The most appropriate initial evaluation of a patient with nontraumatic headache is:
- CT scan of brain
  - EEG
  - MRI scan of brain
  - Thorough neurological evaluation
  - Trial of NSAIDs for pain relief

**Answer: D.** A thorough neurological examination may reveal deficits not seen on gross evaluation, prompting expansion of the differential diagnosis to include more concerning etiologies. Depending on the history and remainder of the physical, a normal neurological examination may be reassuring and obviate need for advanced imaging studies.

- 17.2. In the setting of headache, the presence of nausea and vomiting are diagnostic of which of the following as an underlying cause?
- Glaucoma
  - Increased intracranial pressure
  - Migraine
  - Temporal arteritis
  - None of the above

**Answer: E.** Nausea and vomiting are completely nonspecific. Migraine headaches, increased intracranial pressure, temporal arteritis, and glaucoma can all be manifested by severe nausea and vomiting, as can some systemic viral infections with headache. Such factors may point toward the intensity of the discomfort but are not specific in establishing the diagnosis.

- 17.3. Which of the following causes of headache has a constellation of risk factors that include age older than 50 years, female gender, history of lupus, and previous chronic meningitis?
- Abscess
  - Encephalitis
  - Increased intracranial pressure
  - SAH
  - Temporal arteritis

**Answer: E.** Risk factors associated with temporal arteritis include age older than 50 years; female gender (ratio 4 : 1); history of other collagen vascular diseases, such as lupus; previous chronic meningitis; and previous chronic illness, such as tuberculosis, parasitic infection, and fungal infection.

- 17.4. A history of polycystic kidney disease is an associated risk factor for which of the following potentially catastrophic causes of headache?
- Cerebral venous sinus thrombosis
  - Increased intracranial pressure
  - SAH
  - Subdural hematoma
  - Temporal arteritis

**Answer: C.** A history of polycystic kidney disease is a risk factor for SAH. Other historical details and risk factors for SAH are sudden severe pain, acute severe pain after sexual intercourse or straining, history of SAH or cerebral aneurysm, family history of SAH, severe hypertension, previous vascular lesions in other areas of the body, and being young or middle aged.

## KEY CONCEPTS

- Monocular diplopia persists in one affected eye, even with the other one closed. It is an ophthalmologic problem related to refractory distortions in the light path or from buckling of the retina.
- Binocular diplopia resolves when either eye is closed and is the result of a misalignment in the visual axes.
- Four lines of questioning that help formulate the differential diagnosis of binocular diplopia are as follows: (1) cadence of onset and symptoms (a sudden onset suggests an ischemic event; a fluctuation of symptoms suggests transient ischemic attacks, impending stroke, or neuromuscular disease); (2) directionality and orientation of the diplopia (horizontal, vertical, torsional); (3) presence of pain, which suggests an inflammatory or infectious process, and (4) the presence of other associated symptoms, which suggest a larger disease process (eg, infection, CNS ischemia, neuromuscular disease).
- The diagnostic approach to diplopia entails a methodical consideration of (1) a monocular (refractive) problem, which, when excluded, leads to consideration of (2) a simple restrictive, mechanical orbitopathy, which, when excluded, leads to consideration of (3) a palsy of one or more of the oculomotor cranial nerves, and then (4) a more proximal neuroaxial process involving the brainstem and related cranial nerves; if all else is excluded, then (5) a systemic neuromuscular process.
- An isolated CN III palsy presents with diplopia in all directions of gaze, except on lateral gaze to the affected side, and an eye that is deviated down and out, with a dilated pupil, and ptosis. Microvascular ischemia (typically seen in patients with diabetes), classically spares the pupil. A CN IV palsy results in rotational diplopia that worsens on looking down and toward the nose. A CN VI palsy results in diplopia that worsens on lateral gaze toward the problematic side.
- Simultaneous ipsilateral involvement of more than one of the CN III, IV, or VI nerves from mass, inflammation, or infection in the posterior orbit or cavernous sinus (orbital apex syndrome) may cause a combination of palsies and is associated with retroorbital pain or blurred vision due to venous congestion and possibly ipsilateral numbness or dysesthesia from involvement of the ophthalmic (V1) and maxillary (V2) trigeminal branches that travel through the orbital apex.
- Diplopia from a neuroaxial process involving the brainstem and related cranial nerves may present as (1) a focal lesion in the brainstem (eg, from multiple sclerosis), (2) a more diffuse but still localized brainstem process (eg, from a brainstem tumor or lacunar stroke, impending basilar artery thrombosis, vertebral artery dissection, or an ophthalmoplegic migraine), or (3) as part of a more diffuse neurologic syndrome involving the brainstem and oculomotor nerves (eg, from an infectious, autoimmune, neurotoxic, or metabolic process).
- The diplopia in myasthenia gravis is associated with ptosis, gets worse as the patient fatigues, and improves with rest or on placing ice over the eye.
- The empirical treatment of conditions causing diplopia, instituted even before testing for specific entities is begun, is directed toward imminent threats to airway and ventilation (eg, with botulism and myasthenia gravis), immediate threats to CNS tissue viability (eg, with basilar artery thrombosis or stroke), and rapidly evolving threats to CNS tissue viability (eg, with meningoencephalitis or Wernicke's encephalopathy).

## CHAPTER 18: QUESTIONS &amp; ANSWERS

- 18.1.** A 65-year-old man with a long-standing history of diabetes and hypertension presents with sudden onset of persistent diplopia that began a few hours before arrival. He describes left retro-orbital discomfort, and his examination is notable for a left eye that is deviated laterally and downward, with a palsy of movement medially and upward. He also has a left-sided ptosis but no conjunctival injection, chemosis, or proptosis. His pupils are equal in size at 4mm, round, and equally reactive to light in both a direct and consensual reflex, and his examination is otherwise unremarkable. What is the most likely cause of the diplopia?
- Brain tumor
  - Cerebral aneurysm
  - Microvascular ischemia
  - None of these
  - Orbital apex syndrome

**Answer: C.** Based on examination, this is a patient who has a pupil-sparing CN III (third nerve) palsy. Because his pupillary examination is normal, with an otherwise complete CN III palsy, the so-called rule of the pupil applies. The palsy is very unlikely to be due to external compression from a brain tumor, aneurysm, or orbital apex process. It is a typical presentation of microvascular ischemia, to which the patient is predisposed, given his history of diabetes and hypertension.

- 18.2.** A 56-year-old woman presents with recurrent episodes of diplopia that have been ongoing for a week. She describes double vision that gradually comes and goes, typically worse at the end of the day, with no particular direction or orientation to the diplopia. The patient's coworker, who is present in the emergency department (ED) with her, states that the patient's eyes "looked droopy" during an animated staff meeting they attended that afternoon but look normal now. The patient also describes waxing and waning general muscular weakness that has also been present this past week but denies any other symptoms and

states that when she rests, she feels better. With which entity are her symptoms most consistent?

- Botulism
- Hypothyroidism
- Miller-Fisher syndrome
- Myasthenia gravis
- None of the above

**Answer: D.** The patient and coworker are describing what appears to be an activity-related diplopia, with generalized muscle weakness and lack of other focal symptoms, all very suggestive of a possible neuromuscular process (myasthenia gravis). Miller-Fisher syndrome would not be associated with muscle weakness and would not wax and wane. Botulism would typically have a more progressive course, with other associated bulbar symptoms. Diplopia may be associated with hypothyroidism if it is a presentation of or treatment complication of Graves' disease but would not change so markedly with activity.

- 18.3.** A 76-year-old man with hypertension, hypercholesterolemia, and diet-controlled diabetes presents with a sudden onset of diplopia that developed 30 minutes before arrival. Medics state that the patient's wife reported that he suddenly began staggering around the room, unable to bear weight on his left side. On examination, the patient has normal vital signs except for mild hypertension and has a right CN III palsy, with left arm and leg weakness. He has no airway complaints and denies any pain. What is the most appropriate initial response?
- Checking blood gas levels and assess the patient's negative inspiratory force
  - Emergent treatment with botulinum antitoxin
  - Initiating broad-spectrum antibiotics to cover upper respiratory pathogens
  - Initiating clinical measures to address an acute ischemic stroke
  - A and B

## KEY CONCEPTS

- Critical diagnoses, such as caustic injury, orbital compartment syndrome, and acute angle closure glaucoma, require immediate treatment and ophthalmology consultation.
- Prompt and prolonged irrigation is advised for patients who experience caustic injury to the eye.
- Headache and nausea may be prominent symptoms in patients with acute angle-closure glaucoma.
- Complete abolition of a foreign body sensation after instillation of local anesthesia solution indicates a high likelihood of a superficial corneal lesion.
- Keratitis, inflammation of the cornea, is most commonly caused by a viral infection, but may also be caused by recent ultraviolet light exposure, chemical injury, or hypoxic injury from contact lens use.
- A localized corneal defect with edematous, inflammatory changes may signal corneal ulceration.
- A corneal dendritic pattern may signal a herpetic infection, which can progress to corneal opacification and visual loss.
- Pain, consensual photophobia, peri-limbal conjunctival infection, and a miotic pupil that is caused by ciliary spasm could signal iritis, which is inflammation of the iris and ciliary body, or uveitis, inflammation of the iris, ciliary body, and also choroids. The cause may be trauma or underlying autoimmune disease. The presence of cells and flare in the anterior chamber can help identify these conditions.
- Conjunctivitis is usually self-limited and rarely requires antibiotic treatment.

## CHAPTER 19: QUESTIONS &amp; ANSWERS

**19.1.** Cupping of the optic disk is most commonly seen in which of the following?

- A. Glaucoma
- B. Graves' disease
- C. Pseudotumor
- D. Retinal detachment
- E. Retrobulbar hematoma

**Answer: A.** Cupping of the optic disk results from increased intraocular pressure (IOP) and is seen quite frequently in patients with glaucoma, especially those with long-standing, uncontrolled disease.

**19.2.** A patient who normally wears contact lenses is diagnosed with bacterial conjunctivitis. Which of the following is the preferred treatment in this patient?

- A. Bacitracin
- B. Chloramphenicol
- C. Erythromycin
- D. Moxifloxacin
- E. Sodium sulfacetamide

**Answer: D.** Patients who wear contact lenses are at increased risk for infections with *Pseudomonas* and, in the setting of bacterial conjunctivitis, should be prescribed a quinolone (eg, ciprofloxacin or moxifloxacin) barring any contraindications.

**19.3.** Which of the following provides the longest maximum duration of cycloplegia?

- A. Atropine
- B. Cyclopentolate
- C. Homatropine
- D. Scopolamine
- E. Tropicamide

**Answer: A.** Atropine has a maximum duration of action of 14 days. This is followed by scopolamine with a maximum duration of 7 days, homatropine with 3 days, cyclopentolate with 24 hours, and tropicamide with 6 hours.

**19.4.** A 15-year-old boy presents to the ED after having been shot in the face with a BB gun. He has a solitary penetrating wound just inferior to his left eye. His visual acuity in the left eye is limited to light perception, but he reports having normal vision prior to the injury. He has significant proptosis of his left eye, and his fundus is clearly seen with direct ophthalmoscopy. Intraocular pressure (IOP) of the affected eye is 50 mm Hg. His mental status is normal. What is the most appropriate next step in the management of this patient?

- A. CT scan of the head and face
- B. ED observation with repeated neurologic examinations
- C. Lateral canthotomy and inferior cantholysis
- D. Next-day referral to ophthalmology
- E. Plain radiography of the face

**Answer: C.** The described patient likely has a retrobulbar hematoma with visual acuity changes and an elevated IOP. The elevated IOP with a clear funduscopy are findings consistent with no penetration into the globe. Although CT scan of the head and face is indicated to further delineate specific injuries, lateral canthotomy and inferior cantholysis is emergently necessary for orbital decompression in an attempt to salvage visual function. This sight-saving procedure should not be delayed more than 2 hours after injury when severe findings (decreased visual acuity and significantly increased IOP) are present. Likewise, ophthalmology consultation would be indicated emergently. Plain films of the face would prove of little use in the evaluation of this patient, as would prolonged ED observation.

**19.5.** A 68-year-old woman presents with a sudden, painless, and complete vision loss in her right eye. Upon funduscopic examination of her right eye, she is noted to have a diffusely pale retina with indistinct vessels and a cherry-red fovea centralis. Her left eye is normal. Which of the following is the most likely diagnosis?

- A. Acute angle closure glaucoma
- B. Central retinal artery occlusion
- C. Retinal detachment
- D. Tay-Sachs disease
- E. Temporal arteritis

**Answer: B.** Acute central retinal artery occlusion is characterized by a diffusely pale retina with indistinct or unseen retinal arteries in a patient with sudden, painless, and usually complete visual loss in one eye. Although temporal arteritis can precipitate an occlusion of the retinal artery as one mechanism leading to visual loss and therefore manifest the same findings on funduscopy, this condition is not painless. Patients with temporal arteritis typically have excruciating pain over or in the region of their temporal arteries. Acute angle closure glaucoma is also typically associated with severe pain and has ocular manifestations unlike the ones presented in this case. The funduscopic examination in a patient with retinal detachment reveals a translucent retina that has lifted away from the underlying pigment epithelium. Finally, although patients with Tay-Sachs disease do have a cherry-red fovea, the remainder of the retina is not diffusely pale with poorly visualized vessels. Moreover, Tay-Sachs disease is manifested in the early part of life and would not first be coming to clinical attention in a 68-year-old patient.

**19.6.** A professional boxer presents to the ED after having been punched in the right eye during a boxing match 1 hour ago. He complains of decreased vision in the affected eye and is noted to have significant periorbital swelling and proptosis. Intraocular pressure (IOP) is 35 mm Hg in his right eye. Which of the following is the most likely diagnosis?

- A. Orbital cellulitis
- B. Orbital compartment syndrome
- C. Periorbital cellulitis
- D. Post-traumatic glaucoma
- E. Traumatic iritis

**Answer: B.** The most important cause of post-traumatic proptosis in the ED is the development of retrobulbar hematoma. This is characterized by hemorrhage within the bony orbit and behind the globe. With significant bleeding, an orbital compartment syndrome can occur in which the globe is pushed forward, the optic nerve and retinal artery are stretched and compressed, and the IOP is increased. This is a potentially sight-threatening condition that requires expedient diagnosis and management if the vision is to be salvaged.

**19.7.** A collection of pus in the anterior chamber of the eye is known as which of the following?

- A. Cotton-wool spot
- B. Dacryocystitis
- C. Hyphema
- D. Hypopyon
- E. Keratitis

**Answer: D.** A collection of layered pus in the dependent portion of the anterior chamber is called a *hypopyon*.

**19.8.** Which of the following results from inflammation of a meibomian gland?

- A. Blepharitis
- B. Chalazion
- C. Dacryocystitis
- D. Erysipelas
- E. Hordeolum

**Answer: B.** Inflammation of a meibomian gland with the subsequent formation of a subcutaneous nodule within the eyelid is known as a *chalazion*. This condition typically resolves spontaneously over several days. Authorities often recommend warm compress application and gentle massage of the nodule several times a day, although there is no evidence supporting this. If complete resolution does not occur with 2 weeks, the patient should be referred to an ophthalmologist.

**19.9.** Which of the following pathogens causes a characteristic dendritic lesion on the cornea?

- A. *Chlamydia trachomatis*
- B. Coxsackievirus
- C. Herpes simplex virus
- D. *Neisseria gonorrhoeae*
- E. *Pseudomonas aeruginosa*

**Answer: C.** Herpes simplex virus causes a characteristic corneal dendritic lesion that is readily seen during slit-lamp examination under blue light as fluorescein stain pools in the defect. The importance of recognizing this lesion and diagnosing HSV infection of the eye is tremendous, because infections of the cornea with HSV can rapidly lead to corneal opacification and permanent loss of vision.



## KEY CONCEPTS

- Sore throat is a chief complaint that can represent life-threatening diagnoses and extreme challenges for the emergency clinician, primarily in the form of airway threats and/or deep space infections.
- The five modified Centor criteria award 1 point for each of the following: (1) history of fever; (2) presence of exudates; (3) presence of anterior cervical adenopathy; and (4) absence of cough, and subtract 1 point for (5) age older than 45 years. Patients with scores of –1 to 1 are very unlikely to have GAS infection. Scores of 4 or 5 correspond to a 50% likelihood of GAS, which drops to approximately 30% with a score of 3 and below 20% with a score of 2.
- Physical examination is central to detecting airway threats and determining diagnosis.
- The absence of physical findings during oropharyngeal examination in the setting of severe sore throat symptoms suggests that lower structures may be involved, and endoscopic examination of the upper airway is advisable.
- Antibiotics are more harmful than helpful for patients with viral pharyngitis, which is self-limiting.
- For GAS-proven pharyngitis, a single injection of penicillin or 10-day course of oral penicillin is recommended to decrease the duration of symptoms, transmission to close contacts, and prevention of the rare suppurative and nonsuppurative sequelae.

## CHAPTER 20: QUESTIONS &amp; ANSWERS

**20.1.** When a patient presents to the emergency department (ED) complaining of a sore throat, which is the most valuable component of the diagnostic evaluation?

- A. Computed tomography (CT) evaluation of the soft tissues
- B. Direct visualization of the oropharynx
- C. Plain film radiography
- D. Serologic testing

**Answer: B.** Direct visualization of the pharynx is typically the most helpful portion of the encounter. Thus, complete and unencumbered visualization of the pharyngeal structures is mandatory. Lingual resistance may require coaching or stimulation of a gag reflex, and trismus or pain will often require analgesia. If impressive tonsillar erythema or exudates are observed in a symmetric distribution, and the patient has no signs of airway involvement, acute tonsillitis is present, and further investigation is rarely warranted.

**20.2.** Historically, there was emphasis on determining whether infectious pharyngitis was bacterial or viral in origin. Many industrialized countries have abandoned the search for group A streptococci in the context of pharyngitis for the following reason(s):

- A. All of these.
- B. Antibiotics do not improve the symptoms associated with viral pharyngitis.
- C. Risks of treatment outweigh benefits.
- D. The prevalence of rheumatic fever is exceedingly rare in industrialized nations.

**Answer: A.** The great majority of cases are viral in origin, and suppurative complications following streptococcal infection are easily treated and occur too rarely to justify routine use of antibiotics. Rheumatic fever is a disease that is extremely rare in developed nations. Additionally, adverse events caused by antibiotics are common and frequently result in ED visits.

**20.3.** A 40-year-old man presents with a complaint of sore throat. He is febrile, 102°F (39°C), reports considerable pain with swallowing, and has a moderate sensation of tightness in his throat. On examination, you note that the patient is sitting up; you observe only mild erythema to the tonsillar tissue. What should be the next step?

- A. Discharging patient home with a prescription for nonsteroidal antiinflammatory drugs (NSAIDs)
- B. Intramuscular injection of penicillin
- C. Nasopharyngoscopy at the bedside
- D. Sending the patient to radiology for a CT scan of the neck

**Answer: C.** The severity of his symptoms, which are disproportionate to the physical examination, is concerning for other more sinister diagnoses such as epiglottitis, parapharyngeal abscess, and retropharyngeal abscess.

**20.4.** A healthy 20-year-old, nonsexually active female presents with a complaint of a sore throat. She is febrile and mildly tachycardic. On evaluation, she looks uncomfortable but is in no distress. She has cervical adenopathy, and direct visualization of the oropharynx reveals symmetric tonsillar erythema and diffuse exudates. Ideal management for this patient would include which of the following?

- A. Ceftriaxone, 250 mg IM once
- B. Ibuprofen, 400 mg every 4 to 6 hours, dexamethasone (Decadron), 10 mg once, and acetaminophen-oxycodeone (Percocet), 5/325 mg qid PRN
- C. Ibuprofen 400 mg every 4 to 6 hours, penicillin G IM once
- D. Unasyn (Ampicillin-sulbactam), 3 g IV, and incision and drainage

**Answer: C.** Usually, sore throat is caused by acute pharyngitis, in which case pain management with acetaminophen or NSAIDs is the mainstay of care and the most important initial step in empirical management. The Centor criteria, incorporating components of the history and physical examination to generate an estimate of group A streptococci (GAS), are listed in [Table 20.2](#) with the results of one classic study, and this patient would be a candidate for antibiotic treatment.



## KEY CONCEPTS

- Hemoptysis is caused by infection, trauma, cancer, coagulopathy, or as a complication of invasive pulmonary procedures.
- Plain radiographs are the initial screening test in most cases of massive hemoptysis, although CT scans are more sensitive and can supplant plain chest x-rays as the initial diagnostic test.
- Bronchial artery embolization is highly effective with hemostasis rates ranging from 85% to 95%.
- With massive hemoptysis, hypoxia is the more immediate concern than volume resuscitation, and early intubation to ensure adequate oxygenation is paramount.
- If a tracheo-innominate artery fistula (TIF) is suspected, then overinflation of the tracheostomy balloon or digital pressure at the site of bleeding should be performed for immediate hemorrhage control.

## CHAPTER 21: QUESTIONS &amp; ANSWERS

21.1. What is the most common cause of trace hemoptysis (blood-tinged sputum)?

- A. Bronchiectasis
- B. Bronchitis
- C. Cancer
- D. Congestive heart failure
- E. Pulmonary embolism

**Answer: B.** The most common cause of small-volume hemoptysis is bronchitis.

21.2. Disruption of which of the following vessels is responsible for the vast majority of cases of massive hemoptysis?

- A. Aorta
- B. Bronchial arteries
- C. Pulmonary arteries
- D. Pulmonary veins
- E. Tracheobronchial capillaries

**Answer: B.** Massive hemoptysis almost exclusively involves one of the two sets of vessels that constitute the lung's dual blood supply. Bronchial arteries, direct branches from the thoracic aorta, are responsible for supplying oxygenated blood to the lung parenchyma. Disruption of these vessels can result in sudden and profound hemorrhage. Although small in caliber, the bronchial circulation is a high-pressure system and the cause in nearly 90% of the cases of massive hemoptysis requiring embolization. Although they transmit large volumes of blood, pulmonary arteries are at much lower pressure and, unless affected at a very central location, are less likely to cause massive hemoptysis. Trace hemoptysis typically originates from tracheobronchial capillaries that become disrupted with vigorous coughing or minor bronchial infections.

21.3. Which of the following statements regarding the evaluation of hemoptysis is true?

- A. Chest computed tomography (CT) should not be obtained in patients with massive hemoptysis if this delays initiation of bronchoscopy.
- B. Chest CT should be obtained in any patient with moderate bleeding even if the initial chest radiograph is normal.
- C. Conventional angiography is the preferred diagnostic test to detect both bronchial and non-bronchial arterial causes of massive hemoptysis.
- D. High-resolution multidetector CT, even with recent advances in technology, remains diagnostically inferior to angiography.
- E. In patients with massive hemoptysis, plain films accurately localize the site of hemorrhage in less than 50% of patients.

**Answer: B.** In patients with massive hemoptysis, plain films may localize the site of hemorrhage in as many as 80% of patients.

However, high-resolution multidetector CT of the chest is the principal diagnostic test to detect both bronchial and non-bronchial arterial causes of massive hemoptysis. CT is diagnostically comparable with, but less invasive than, conventional angiography, which currently is done as a combined diagnostic/therapeutic modality. A chest CT scan should be obtained in high-risk patients (smokers and oncology patients) or in any patient with moderate-to-severe bleeding even if the initial chest radiograph is normal. CT localization of hemorrhage can expedite bronchoscopic evaluation or guide subsequent interventional procedures.

21.4. A 50-year-old man presents after an episode of hemoptysis. He describes coughing up several large clots of dark blood. During his evaluation, he coughs and expectorates approximately 5 mL of clotted blood. The patient's vital signs are normal, and no abnormalities are noted on physical examination. His chest radiograph is normal. Which of the following is the most appropriate next step in the management of this patient?

- A. Admission to an observation unit
- B. Consultation for bronchoscopy
- C. Consultation for percutaneous embolization
- D. Discharge home with follow-up in 24 hours
- E. Obtain chest CT scan

**Answer: E.** Since the advent of high-resolution CT, radiologic evaluation has had an integral role in the evaluation and management of patients with hemoptysis. Unless the initial chest radiograph is diagnostic or the patient is hemodynamically unstable, a chest CT scan should be obtained in most cases. Further management strategy should occur in conjunction with pulmonary and thoracic surgery consultants, guided by the CT results.

21.5. A 58-year-old man with a single lung transplant presents to the emergency department (ED) with what appears to be large-volume hemoptysis. He was just discharged from the endoscopy suite, where he had a number of surveillance biopsies performed. He looks pale and diaphoretic with an initial oxygen saturation of 71%. After placement of an intravenous line and supplemental oxygen, the next most appropriate step is:

- A. Blood transfusion
- B. Contrast-enhanced CT scan of the chest
- C. Intubation
- D. Thoracic surgery consultation

**Answer: C.** This patient is profoundly hypoxic, will need imaging outside of the ED, and invasive procedures. All resuscitative and procedural efforts will be futile without intubation and maximal oxygenation.

## KEY CONCEPTS

- Dyspnea results from a variety of conditions, ranging from nonurgent to life-threatening. Neither the clinical severity nor the patient's perception correlates well with the seriousness of underlying pathology.
- Dyspnea is subjective and the differential diagnosis can be divided into acute and chronic causes, of which many are pulmonary. Other causes include cardiac, metabolic, infectious, neuromuscular, traumatic, and hematologic conditions.
- Chronic or progressive dyspnea usually denotes primary cardiac or pulmonary disease. Acute dyspneic spells may result from asthma exacerbation; infection; pulmonary embolus; intermittent cardiac dysfunction; psychogenic causes; or inhalation of irritants, allergens, or foreign bodies.
- All patients experiencing dyspnea, regardless of possible cause, should be promptly evaluated in the treatment area. Bedside pulse oximetry readings should be obtained, and the patient placed on a cardiac monitor.
- If the pulse oximetry result is less than 95% on room air, the patient should be placed on supplemental oxygen either by nasal cannula or mask, depending on the degree of desaturation.
- If necessary, breathing should be assisted with manual or mechanical ventilation, either noninvasively for the short term, or with the patient tracheally intubated for airway protection for prolonged ventilation.
- Unstable patients or patients with critical diagnoses must be stabilized and require admission to an intensive care unit. Emergent patients who have improved in the ED may be admitted to an intermediate care unit. Most patients in the nonurgent category can be treated as outpatients if medical follow-up can be arranged.

## CHAPTER 22: QUESTIONS &amp; ANSWERS

22.1. Hyperpnea is best defined by which of the following?

- A. A respiratory rate greater than normal
- B. A tidal volume that exceeds metabolic demands
- C. Decreased end-tidal carbon dioxide levels
- D. Elevated functional residual capacity
- E. Greater-than-the-normal minute ventilation necessary to meet metabolic demands

**Answer: E.** Hyperpnea is greater-than-the-normal minute ventilation necessary to meet metabolic demands.

22.2. Stridor is most likely due to:

- A. Bronchospasm
- B. Guillain-Barré syndrome
- C. Laryngeal edema
- D. Malignancy
- E. Pulmonary embolism

**Answer: C.** Stridor is an upper airway noise caused by airway narrowing. Of the given options, stridor is most likely due to laryngeal edema.

22.3. A 34-year-old male was struck repeatedly with a pipe in the right chest. He becomes acutely more dyspneic during emergency medical services (EMS) transport and becomes clammy, hypotensive, and more tachycardic on arrival to the emergency department (ED). Examination reveals tachypnea, crepitance, and subcutaneous air over the right chest, with decreased breath sounds. The most appropriate next action is:

- A. 1-L intravenous (IV) fluid bolus
- B. Needle chest decompression of the right chest

C. Perform portable chest radiograph

D. Provide supplemental oxygen by non-rebreather mask

E. Rapid sequence intubation (RSI) and endotracheal intubation

**Answer: B.** Needle chest decompression is indicated for management of a likely tension pneumothorax. If ultrasound is immediately available, it can be used to confirm pneumothorax, but in this patient, who is in cardiovascular collapse, immediate intervention is necessary.

22.4. A 49-year-old female presents with acute onset of dyspnea. Which of the following findings is most suggestive of a primary cardiac etiology?

- A. Hampton's hump on chest radiograph
- B. Positive amino-terminal pro-B-type natriuretic peptide (NT-proBNP)
- C. Positive D-dimer
- D. Positive Homans' sign
- E. S1Q3T3 on electrocardiography (ECG)

**Answer: B.** Positive NT-proBNP. Although this may be positive with heart failure or pulmonary embolism (PE), this is the best choice. S1Q3T3, Hampton's hump, D-dimer, and Homans' sign are more associated with PE than primary cardiac etiology.

## KEY CONCEPTS

- Tension pneumothorax is a clinical diagnosis, treated with needle decompression, followed by tube thoracostomy.
- Patients with suspected ACS are risk-stratified by history, ECG, and troponin levels. Those with ST segment elevation myocardial infarction (STEMI) undergo fibrinolysis or percutaneous transluminal coronary angioplasty (PTCA). Those with non-ST segment elevation myocardial infarction (NSTEMI) do not require immediate PTCA. Those with a nondiagnostic ECG and troponin level are managed with observation.
- Thoracic dissection is diagnosed with CT angiography. The initial management of dissection is with urgent control of heart rate, followed by lowering of blood pressure. Further management, medical or surgical, depends on the location of the dissection.
- Pulmonary embolism is diagnosed using a combination of serum D-dimer measurement and imaging, usually CT angiography. Patients with a low pretest probability and normal D-dimer level do not have pulmonary embolism as the cause of their chest pain presentation.
- Patients with pericardial effusions undergo echocardiography to evaluate for cardiac tamponade. Those with signs of shock may require emergent pericardiocentesis.

## CHAPTER 23: QUESTIONS &amp; ANSWERS

- 23.1. A patient presents with the sudden onset of unilateral chest pain, followed almost immediately by respiratory distress. He is noted to have a blood pressure of 75/45 mm Hg, pulse of 130 beats/min, and decreased breath sounds on the right side of his chest. What is the most appropriate initial step in the management of this patient?
- Administer intravenous (IV) antibiotics.
  - Infuse a 2-L bolus of normal saline.
  - Obtain a chest radiograph.
  - Obtain an electrocardiogram (ECG).
  - Perform a tube thoracostomy.

**Answer: E.** Tension pneumothorax is a critical diagnosis that must be made and remedied, if present, in the first few moments of the rapid stabilization and assessment phase of any patient encounter. If a patient presents with chest pain, respiratory distress, shock, and unilateral reduction or absence of breath sounds, immediate intervention with needle or tube thoracostomy is required.

- 23.2. A 65-year-old man with a past medical history of prostate cancer presents with chest pain. His blood pressure is 60/40 mm Hg, and his pulse is 145 beats/min. The ECG shows diffuse ST segment elevation, and cardiomegaly is seen on his chest radiograph. What is the most appropriate first step in the management of this patient?
- Administration of dobutamine
  - Administration of dopamine
  - Cardiac catheterization
  - Cardiac ultrasonography
  - Thrombolysis

**Answer: D.** Prompt bedside cardiac ultrasonography would be the most appropriate next step in the management of this patient, who presents with symptoms and signs of pericardial effusion with tamponade. If confirmed by ultrasonography, immediate pericardiocentesis would logically follow in an effort to reverse the signs of shock in this patient. Other signs that could accompany the presentation are low voltage on the ECG and elevated jugular venous pressure on examination.

- 23.3. A “tearing” sensation is classically described for which of the following causes of chest pain?
- Aortic dissection
  - Coronary spasm
  - Esophageal rupture
  - Mallory-Weiss tear
  - Pneumothorax

**Answer: A.** “Tearing” pain that may migrate from the front to back or back to front is classically described in aortic dissection. Descriptions such as “squeezing,” “crushing,” or “pressure” lead to the suspicion of a cardiac ischemic syndrome, although cardiac ischemia can be characterized by nonspecific discomfort, such as “bloating” or “indigestion.” “Sharp” or “stabbing” pain is seen more in pulmonary and musculoskeletal diagnoses. Patients complaining of a burning- or indigestion-type of pain may initially be suspected of having a gastrointestinal cause; however, because of the visceral nature of chest pain, all causes of pain may present with any of the preceding descriptions.

- 23.4. Uremia is a risk factor associated with which of the following causes of chest pain?
- Acute coronary syndrome
  - Aortic dissection
  - Pericarditis
  - Pneumothorax
  - Pulmonary embolism

**Answer: C.** Uremia is a risk factor for the development of pericarditis. Other risk factors associated with the development of pericarditis include infection, autoimmune disease, acute rheumatic fever, recent myocardial infarction or cardiac surgery, malignancy, radiation therapy to the mediastinum, and prior pericarditis.

- 23.5. A narrow pulse pressure is more closely associated with which of the following diagnoses?
- Acute myocardial infarction
  - Aortic dissection
  - Pericarditis with effusion
  - Pneumothorax
  - Pulmonary embolism

**Answer: C.** A narrow pulse pressure is a pivotal finding in the diagnosis of pericarditis with associated pericardial effusion. Other characteristic, but less specific, potential findings in the patient with pericarditis include hypotension, tachycardia, fever, and jugular venous distention (JVD). The more specific finding of pericardial rub is also heard in some patients with pericarditis.

- 23.6. The finding of Hamman’s sign is most consistent with which of the following?
- Cholecystitis
  - Mediastinitis
  - Pericarditis
  - Pulmonary embolus
  - Unstable angina

**Answer: B.** Hamman’s sign is an audible systolic “crunch” heard on cardiac auscultation that is produced by the heart moving against air in the mediastinum. This can be heard in conditions such as esophageal rupture, mediastinitis, and pneumomediastinum.

- 23.7. Right ventricular strain on the ECG of a patient complaining of chest pain would be most consistent with which of the following diagnoses?
- A. Acute myocardial infarction
  - B. Coronary ischemia
  - C. Coronary spasm
  - D. Pericarditis
  - E. Pulmonary embolus

**Answer: E.** In the setting of chest pain, right ventricular strain as evidenced on the ECG is highly suspicious for pulmonary embolus.

- 23.8. The ECG finding of PR segment depression would be more commonly found in which of the following causes of chest pain?
- A. Pericarditis
  - B. Pulmonary embolus
  - C. ST segment elevation myocardial infarction (STEMI)
  - D. Subendocardial infarction
  - E. Unstable angina

**Answer: A.** The electrocardiographic findings most commonly associated with pericarditis are diffuse ST segment elevation and PR segment depression. The ECG in patients with unstable angina is most often normal or nonspecific. T wave inversion may be seen in these patients. The characteristic ECG findings with subendocardial infarction are T wave inversion and/or ST segment depression in concordant leads. Classic STEMI is manifested electrocardiographically by ST segment elevation (>1 mm) in contiguous leads, a new left bundle branch block (LBBB), or Q waves 0.04 second or more in duration. Many possible electrocardiographic findings are associated with pulmonary embolus, usually manifestations of right ventricular strain.

## KEY CONCEPTS

- Certain patients with abdominal pain, including elder patients, women of reproductive age, the immunocompromised, patients with cancer, and those who have undergone prior surgery (especially bariatric surgery) are more likely to harbor a serious diagnosis for their abdominal pain presentation and more often require imaging than their otherwise healthy counterparts.
- Early bedside ultrasound is indicated for patients with signs of shock. Ultrasound may identify aortic aneurysm or free intra-peritoneal blood, indicating the need for rapid surgical intervention.
- The WBC count is non-diagnostic in the evaluation of patients with abdominal pain, and neither elevation nor normal range results should be considered confirmatory of a diagnostic impression.
- Ultrasound is superior to CT scanning for the diagnosis of pain originating in the biliary tract or pelvis. Most abdominal pain can be diagnosed with non-contrast or IV contrast only CT scan.
- Plain radiographs are rarely useful, and should only be obtained in the rapid detection of free air or obstruction, when there is no intent to proceed to CT scan if the radiograph is positive or negative.
- Pain medication does not impede diagnosis and should not be withheld during diagnostic evaluation.
- Close to half of all patients with abdominal pain will not get a definitive diagnosis in the ED. Select populations may be suitable for discharge with appropriate close follow-up.
- First line antibiotics for serious intraperitoneal infections should be broad spectrum, including anaerobic coverage, such as piperacillin/tazobactam 3.375 g or ciprofloxacin 500 mg plus metronidazole 500 mg.

## CHAPTER 24: QUESTIONS &amp; ANSWERS

24.1. Referred pain from pancreatitis is commonly localized to what anatomic area?

- A. Left flank
- B. Left shoulder
- C. Midback
- D. Rectum
- E. Right shoulder

**Answer: C.** Pain from acute pancreatitis is usually localized in the epigastric area and radiates to the midback. Pain from spleen is usually referred to the left shoulder, while a perforated ulcer may refer to the right shoulder. Uterine or rectal pain is commonly referred to the low back.

24.2. Which of following disease processes does not usually cause colicky pain?

- A. Diarrhea
- B. Gallstone
- C. Intestinal obstruction
- D. Pancreatitis
- E. Ureteral stone

**Answer: D.** Colicky pain is described as “waxing and waning” and usually arises from hollow organs, such as the gallbladder, ureters, or small/large intestines. Pain from pancreatitis is usually constant and severe.

24.3. Bedside ultrasonography is helpful in making which of the following diagnoses?

- A. Cholecystitis
- B. Free intraperitoneal hemorrhage from trauma
- C. Hydronephrosis from ureteral stone

- D. Ruptured abdominal aneurysm
- E. Ruptured ectopic pregnancy
- F. All of the above

**Answer: F.** Clinician-performed ultrasonography is a useful tool in the diagnosing all the above disease processes.

24.4. What intraabdominal processes are best visualized on ultrasound rather than CT?

- A. Biliary and ovarian
- B. Biliary and perirectal
- C. Gastric and hepatic
- D. Hepatic and splenic
- E. Ovarian and small bowel

**Answer: A.** Ultrasonography is more sensitive in detecting biliary pathology, which can be more subtle on CT scans, as well as assessing for flow in ovarian torsion.

24.5. Which of the following populations warrants more careful evaluation for abdominal pain?

- A. Immunocompromised patients
- B. Patients older than 65 years
- C. Patients with a language or communication barrier
- D. Patients with prior bariatric surgery
- E. Pregnant women
- F. All of the above

**Answer: F.** All of the above patients have been shown to exhibit increased complications and morbidity when presenting with abdominal pain.

## KEY CONCEPTS

- Clinical jaundice is usually not evident until the total serum bilirubin concentration rises above 2.5 mg/dL.
- Bile metabolism may be altered when there is an overproduction of heme products (hemolysis); failure of the hepatocyte to take up, conjugate, and excrete bilirubin (hepatocellular dysfunction); or obstruction of biliary excretion into the intestine.
- Unconjugated bilirubin that is not bound to albumin can cross the blood-brain barrier, causing adverse neurologic effects; conjugated bilirubin is not neurotoxic.
- New-onset painless jaundice is the classic presentation for a neoplasm involving the head of the pancreas.
- Jaundice is first apparent sublingually, in the conjunctiva and on the hard palate.
- In cases of unexplained hepatocellular injury, a quantitative acetaminophen level may be helpful.
- If the etiology of the ascites is unknown, getting the serum ascites albumin gradient (SAAG) will aid in determining the cause of ascites and presence of portal hypertension.
- Ultrasonography is the preferred initial modality to evaluate whether or not biliary obstruction is present, whereas CT is preferred if malignant obstruction is suspected or the entire abdomen needs to be evaluated.
- Elevated direct bilirubin with transaminase elevation is indicative of hepatocellular inflammation or injury.
- Diagnosis of spontaneous bacterial peritonitis (SBP) is  $>250$  neutrophil count. Treatment is cefotaxime 2 grams.
- Hyperemesis gravidarum can elevate liver enzymes up to 20 times the normal amount, including mildly elevated bilirubin.
- Intrahepatic cholestasis of pregnancy is an idiopathic cause of jaundice that occurs in the third trimester.

## CHAPTER 25: QUESTIONS &amp; ANSWERS

**25.1.** A 56-year-old male presents with fever, distended abdomen, and a bedside ultrasound that shows ascites. A paracentesis is performed and the results indicate that the patient has spontaneous bacterial peritonitis (SBP). What daily medication should be stopped upon admission?

- A. Amlodipine
- B. Crestor
- C. Lactulose
- D. Metoprolol

**Answer: D.** Beta Blocker use in pts with cirrhosis with SBP should be discontinued because it has been shown to increase mortality.

**25.2.** A 43-year-old female presents with 1 month of abdominal swelling. On examination she has a diffusely swollen abdomen with a fluid wave. The patient appears to have new onset ascites. In order to help determine the etiology, you obtain the serum ascites albumin gradient (SAAG). Which value is consistent with cirrhosis?

- A. 0.25 g/dL
- B. 0.5 g/dL
- C. 1 g/dL
- D. 1.5 g/dL

**Answer: D.** A (SAAG) value of greater than or equal to 1.1 g/dL is found in patients with portal hypertension. There are many causes of portal hypertension, including cirrhosis, liver failure, and heart failure.

**25.3.** A 48-year-old male with a history of cirrhosis presents with 3 days of abdominal pain and fever. On examination, he is febrile and has an abdominal examination that is diffusely tender with guarding. The decision is made to do a paracentesis to evaluate for spontaneous bacterial peritonitis (SBP). What is the best treatment for SBP?

- A. Cefotaxime and discontinue beta blockers
- B. Ceftriaxone and dexamethasone

- C. Ceftriaxone and discontinue beta blockers
- D. Ciprofloxacin and metronidazole

**Answer: A.** The empirical antibiotic of choice is a third-generation cephalosporin (eg, cefotaxime). If the patient has a history of cirrhosis and is taking a nonselective beta blocker, it should be discontinued because it has been shown to increase mortality in patients with SBP.

**25.4.** A 41-year-old male with a history of cirrhosis presents with fever, abdominal distension, and confusion. A paracentesis is performed in the evaluation of spontaneous bacterial peritonitis (SBP). What is the diagnostic criteria found in the ascitic fluid that confirms SBP?

- A. Neutrophil count  $>100$
- B. Neutrophil count  $>250$
- C. WBC  $>100$
- D. WBC  $>250$

**Answer: B.** The presence of more than 250 polymorphonuclear cells per cubic millimeter of ascitic fluid is diagnostic for SBP.

**25.5.** A 55-year-old female presents with 1 month of diffuse abdominal swelling and pain. She reports a long history of alcohol use. In the evaluating this patient for jaundice, how high does the bilirubin have to be to become clinically apparent, and what area of the body does jaundice appear first?

- A. 2 mg/dL; nail beds
- B. 2 mg/dL; sclera
- C. 2.5 mg/dL; skin
- D. 2.5 mg/dL; sublingual

**Answer: D.** Clinical jaundice is usually not evident until the total serum bilirubin concentration rises above 2.5 mg/dL. Jaundice is first apparent sublingually, in the conjunctiva and on the hard palate.



## KEY CONCEPTS

- Nausea and vomiting can result from a primary problem in the GI tract but can also be secondary to problems in the neurological, vestibular, urogenital, and cardiac systems.
- Associated symptoms and a medication/drug history are the most helpful in narrowing the differential diagnosis in the acutely vomiting patient.
- Laboratory studies are not required in all patients who vomit. Patients with severe or protracted vomiting, sufficient to require IV rehydration, should have their electrolytes and renal function determined and corrected.
- In a patient with undifferentiated nausea or vomiting or vomiting due to non-obstructive GI disease, ondansetron is the first line antiemetic.
- Although evidence is limited, metoclopramide is the antiemetic of choice in hyperemesis gravidarum and vomiting associated with headache; ondansetron is the drug of choice in chemotherapy induced vomiting.
- Antiemetics should not be prescribed routinely in patients receiving opioid analgesia.

## CHAPTER 26: QUESTIONS &amp; ANSWERS

26.1. Which of the following metabolic derangements is most likely in a patient with severe, protracted vomiting?

- A. Hypochloremic, hypokalemic, metabolic alkalosis
- B. Hypochloremic, hypokalemic, metabolic acidosis
- C. Hyperchloremic, hypokalemic, metabolic alkalosis
- D. Hyperchloremic, hypokalemic, metabolic acidosis
- E. Hyperchloremic, hyperkalemic, metabolic acidosis

**Answer: E.** Severe, protracted vomiting can cause a hypochloremic, hypokalemic, metabolic alkalosis. The metabolic alkalosis is produced by loss of hydrogen ions in the vomitus. Many factors serve to maintain the alkalosis including volume contractions, hypokalemia, chloride depletion, shift of extracellular hydrogen ions into cells, and increased aldosterone. Hypokalemia is produced primarily by loss of potassium in the urine. The metabolic alkalosis leads to large amounts of sodium bicarbonate being delivered to the distal tubule. Secondary hyperaldosteronism from volume depletion causes reabsorption of sodium and excretion of large amounts of potassium in the urine.

26.2. Antihistamines would most effectively control the nausea and vomiting caused by which of the following conditions?

- A. Chemotherapy administration
- B. Digoxin ingestion
- C. Gastritis
- D. Gastroparesis
- E. Labyrinthitis

**Answer: E.** Antihistamines are useful in nausea and vomiting associated with labyrinthitis, motion sickness, and vestibular disorders by directly inhibiting vestibular stimulation and vestibular-cerebellar pathways. Their anticholinergic effect may also contribute to their effectiveness in vertigo and motion sickness.

26.3. A 35-year-old man is given 10 mg of IV prochlorperazine for treatment of nausea. Fifteen minutes after the administration of medication, he displays protrusion of his tongue, difficulty speaking, intermittent contractions of his facial muscles, and anxiety. Which of the following would be the most appropriate next step in the management of this patient?

- A. Administer benzotropine mesylate
- B. Administer haloperidol
- C. Five-point physical restraints

D. Rapid sequence intubation

E. Repeat dose of prochlorperazine

**Answer: A.** The described patient is experiencing a dystonic reaction to prochlorperazine (Compazine). Drug-induced dystonic reactions most commonly occur with antipsychotic, antidepressant, and antiemetic medications. Administration of an anticholinergic medication such as benzotropine mesylate (Cogentin) or diphenhydramine (Benadryl) is the treatment of choice and typically aborts the reaction. Benzodiazepine administration may occasionally be necessary if the previously mentioned medications are ineffective. Artificial airway placement and use of restraints are rarely required. Further dopamine receptor blockade with haloperidol or additional doses of the offending agent would not prove useful.

26.4. Where is the principal site of action of the serotonin receptor antagonist ondansetron?

- A. Area postrema
- B. Basal ganglia
- C. GI tract
- D. Hypothalamus
- E. Vestibular system

**Answer: A.** The serotonin receptor antagonists such as ondansetron, granisetron, and tropisetron are a class of agents that have generated much interest secondary to their effect on chemotherapy-induced emesis. Their principal site of action is the area postrema, which is located in the lateral reticular formation of the medulla. They also exert some effect on receptors of the GI tract; however, this is secondary to their effect in the area postrema.

26.5. What is the most common cause of nausea and vomiting in the adult population?

- A. Acute gastroenteritis
- B. Drug side effects
- C. Febrile systemic illness
- D. Motion sickness
- E. Pregnancy

**Answer: B.** In adult medicine, nausea and vomiting are caused most often by medications. When considering the entire population (pediatrics and adults), the three most common causes of nausea and vomiting are acute gastroenteritis, febrile systemic illnesses, and drug effects.

## KEY CONCEPTS

- Several risk scoring systems, including the Blatchford and Rockall scoring systems, can help emergency clinicians stratify UGIB patients into low- and high-risk groups for adverse outcomes, with high-risk patients defined as those who require a blood transfusion or endoscopic or surgical intervention during their admission.
- Patients who are not at high risk and are without comorbid diseases, have normal vital signs, normal or trace positive results on stool guaiac testing, normal hemoglobin and hematocrit levels, good support systems, proper understanding of signs and symptoms of significant bleeding, and access to emergent care and 24-hour follow up may be discharged.
- Nasogastric lavage is an uncomfortable procedure that has low sensitivity and is not indicated in the acute management of UGI bleeding.
- IV administration of proton pump inhibitors, such as pantoprazole, 40 mg IV bid, should be initiated in the emergent setting for patients with significant UGIB. Alternatively, in patients with significant acute GIB, we recommend an 80 mg IV bolus of omeprazole followed by 8 mg/hr continuous infusion for 3 days.
- A BUN-to-creatinine ratio greater than 36 in the setting of no renal failure can be highly suggestive of UGIB.
- Electrocardiography should be performed in older adults or those with known coronary artery disease who are at higher risk for demand ischemia in the setting of hypotension or anemia due to a GIB.

## CHAPTER 27: QUESTIONS &amp; ANSWERS

- 27.1. Which of the following cannot clinically mimic hematemesis?
- Dental bleeding
  - Bismuth-containing medication
  - Oral trauma or injury
  - Red food coloring
  - Severe epistaxis

**Answer: B.** When evaluating a patient with an upper gastrointestinal (GI) bleed, one must consider other potential causes that are not related to the GI tract. Epistaxis, dental bleeding, oral trauma, and red food coloring can mimic the appearance of hematemesis. Bismuth-containing medication can create melanotic-appearing, guaiac-negative stools, so this presentation is not truly consistent with the findings of hematemesis and a possible upper GI bleed.

- 27.2. A 56-year-old man presents with nausea, vomiting, and hematemesis since early this morning. He reports vomiting a combination of coffee-ground emesis and, more recently, bright red blood. His past medical history is significant for heavy alcohol use and known esophageal varices. On arrival, he is pale and diaphoretic. His vitals are remarkable for a blood pressure of 90/54 mm Hg and a regular heart rate of 118 beats/min. What is the most appropriate initial step in management?
- Consult a gastroenterologist for immediate endoscopy.
  - Perform a rectal examination to confirm a gastrointestinal bleed.
  - Perform electrocardiography to evaluate a cardiac cause for the patient's presentation.
  - Perform emergent abdominal plain radiography to evaluate the cause of the GI bleed.
  - Place two large-bore intravenous catheters and begin crystalloid resuscitation.

**Answer: E.** If a patient with a reported GI bleed is unstable, the initial step in management involves resuscitation with the immediate placement of two large-bore intravenous catheters (18 gauge or larger) and crystalloid infusion. Other diagnostic measures, such as performing electrocardiography or imaging, can be carried out after the initial step of gaining venous access and initiating resuscitation. It is important to note that abdominal plain films are rarely helpful in patients with GI bleeding unless bowel obstruction is suspected. Gastroenterology consultation is an important part of this patient's care plan; however, it is not the first step in management after the evaluation.

- 27.3. A 65-year-old man presents with weakness, fatigue, melena, and increasing amounts of coffee-ground emesis

over the last 24 hours. The patient has a known history of cirrhosis and heavy alcohol abuse. On examination, he is pale and diaphoretic and has rectal findings showing a combination of melena and hematochezia. His vital signs show a blood pressure of 75/40 mmHg and a regular heart rate of 125 beats/min. You place two large-bore intravenous (IV) catheters and attempt to resuscitate the patient with crystalloid, but the patient shows no improvement after 2 L of fluid. At this point, the management of this patient should include all of the following, except which one?

- Emergent gastroenterology consultation for endoscopy
- Emergent intensive care unit (ICU) consultation for admission, further evaluation, and monitoring
- Placement of a nasogastric (NG) tube with gastric lavage
- Transfusion of 1 unit of fresh frozen plasma (FFP) for every 4 units of packed red blood cells
- Transfusion of packed red blood cells

**Answer: C.** Placement of an NG tube in suspected upper GI bleed is not recommended. The sensitivity of this modality for predicting upper GI bleed is low, and there is a negative likelihood ratio in patients with melena or hematochezia. Along with this, NG tube placement has been associated with severe complications, including aspiration, pneumothorax, perforation, and development of gastric lesions. Transfusion of packed red blood cells and FFP is indicated here because the patient is hemodynamically unstable and likely to be suffering from coagulopathy resulting from his liver disease. Both GI and ICU consultation should be pursued because the patient will require endoscopy and close monitoring.

- 27.4. Which of the following statements regarding the epidemiology of GI bleeding is correct?
- LGIB affects a larger portion of patients than does UGIB.
  - LGIB requiring admission is more common in adults than in children.
  - Most deaths secondary to GI bleeding occur in patients older than 60 years.
  - Overall mortality has remained the same over the past 20 years.
  - UGIB is more common in women than in men.

**Answer: C.** The overall mortality of GI bleeding is approximately 13% to 14% and has not changed significantly since the 1960s. LGIB affects a smaller portion of patients and results in proportionally fewer hospital admissions than UGIB. GI bleeding can occur in individuals of any age but usually affects people in their

40s through 70s (mean age, 59 years). Most deaths caused by GI bleeding occur in patients older than 60 years. UGIB is more common in men than in women (2:1), whereas LGIB is more common in women. Significant UGIB requiring admission is more common in adults, whereas LGIB requiring admission is more common in children.

**27.5.** What is the most common cause of significant upper GI bleeding in adults?

- A. Duodenitis
- B. Esophagitis
- C. Gastric erosions
- D. Peptic ulcer disease
- E. Varices

**Answer: D.** The most common cause of significant upper GI bleeding in adults is peptic ulcer disease. In descending order of frequency, this is followed by gastric erosions, varices, Mallory-Weiss tear, esophagitis, and duodenitis.

**27.6.** What is the most common cause of significant lower GI bleeding in adults?

- A. Cancer
- B. Diverticular disease
- C. Inflammatory bowel disease
- D. Rectal disease
- E. Upper GI bleeding

**Answer: B.** The most common cause of significant lower GI bleeding in adults is diverticular disease. In descending order of frequency, this is followed by angiodysplasia, upper GI bleeding, cancer or polyps, rectal disease, and inflammatory bowel disease.

**27.7.** What is the most common cause of upper GI bleeding in children?

- A. Esophageal varices
- B. Esophagitis
- C. Gastric and duodenal ulcers
- D. Gastritis
- E. Mallory-Weiss tear

**Answer: C.** Gastric and duodenal ulcers are the most common cause of upper GI bleeding in children. In descending order of frequency, this is followed by esophagitis, gastritis, esophageal varices, and Mallory-Weiss tear.

**27.8.** What is the most common cause of lower GI bleeding in children?

- A. Anorectal fissure
- B. Infectious colitis
- C. Inflammatory bowel disease
- D. Intussusception
- E. Polyps

**Answer: A.** Anorectal fissure is the most common cause of lower GI bleeding in children. In descending order of frequency, this is followed by infectious colitis, inflammatory bowel disease, polyps, intussusception, and Meckel's diverticulum.

**27.9.** Which of the following has been shown to decrease rebleeding occurrences effectively in patients treated for upper GI bleeding secondary to esophageal varices?

- A. Cimetidine
- B. Famotidine
- C. Octreotide
- D. Omeprazole
- E. Vasopressin

**Answer: C.** Octreotide is a useful addition to endoscopic sclerotherapy and decreases rebleeding occurrences. Patients with documented esophageal varices and acute upper GI bleeding should be treated with an intravenous infusion of DAM, 50 µg/hr, for a minimum of 24 hours while being observed in the intensive care unit.

**27.10.** Emergent surgical consultation should be obtained in a patient with GI bleeding and which of the following?

- A. Esophageal varices
- B. History of abdominal aortic graft
- C. Initial systolic blood pressure < 100 mm Hg
- D. Liver disease
- E. Transfusion requiring 4 units of blood

**Answer: B.** Emergent surgical consultation is needed for patients who have abdominal aortic grafts and who present to the emergency department with GI bleeding because of the possibility of an aortoenteric fistula. Consultation with a surgeon should be obtained if it appears that more than 5 units of blood is required to achieve hemodynamic stability or if there is reasonable suspicion that operative intervention may be needed. This is especially true for patients older than 65 years. Patients with a history of varices, persistent postural changes in heart rate, or significant bright red blood per rectum are more likely to require surgery than patients without these findings.

## KEY CONCEPTS

- Hospital acquired *C. difficile* and norovirus infection are the most prevalent causes of fatal illness from diarrhea in the United States.
- Key elements of the history in the patient with diarrhea include recent travel, immunosuppression, hospitalization, and antibiotic use.
- Acute diarrhea is most often viral and treated with supportive therapy.
- Fluids with excess sugar, caffeine, and high fat content should be avoided in patients with diarrhea.
- In nontoxic patients, loperamide, initial dose of 4 mg and subsequent doses of 2 mg after each loose stool (not to exceed 16 mg in 24 hours), is safe and effective in providing symptom control.
- Ciprofloxacin 500 mg orally twice daily or levofloxacin (Levaquin) 500 mg once daily are effective empirical treatments for systemically ill appearing adults with suspected traveler's diarrhea.
- *C. difficile* treatments include metronidazole 500 mg orally three times daily for 10 to 14 days as initial treatment or vancomycin 125 mg four times daily orally for 10 to 14 days.
- Quantitative PCR is sensitive in testing for *C. difficile*.
- Use of probiotics reduces stool frequency and shortens duration of acute infectious diarrhea.

## CHAPTER 28: QUESTIONS &amp; ANSWERS

**28.1.** What is the most common pathogenic cause of diarrheal illnesses in the United States?

- A. Adenoviruses
- B. *Escherichia coli*
- C. Noroviruses
- D. Rotaviruses
- E. *Salmonella*

**Answer: C.** The two major categories of diarrhea-associated illness are infectious and noninfectious. Infectious causes represent approximately 85% of cases, whereas noninfectious causes represent only 15%. By far, the most common pathogens causing infectious diarrheal illnesses in the United States are noroviruses. The more than 100 different strains of noroviruses are responsible for 90% of diarrheal illnesses in the United States.

**28.2.** What is the most common type of diarrhea seen in emergency departments (EDs)?

- A. Dysenteric diarrhea
- B. Inflammatory diarrhea
- C. Invasive diarrhea
- D. Osmotic diarrhea
- E. Secretory diarrhea

**Answer: E.** Diarrhea results from one or more of four different pathologic processes that are characteristic of the primary cause and contribute to the decreased absorption in the gut. Secretory diarrhea is caused by pathogens that produce cytotoxins that increase cellular permeability and cause the oversecretion of water and electrolytes. Noninfectious causes of secretory diarrhea include medications, toxic substances, endocrine disorders, and neoplasias. Most cases of diarrhea encountered in the ED are secretory. Inflammatory diarrhea, also described as invasive diarrhea or dysentery, results from cellular damage to the intestinal mucosa, leading to the secretion of water, electrolytes, blood, mucus, and plasma proteins. Osmotic diarrhea occurs with the ingestion or malabsorption of osmotically active solutes. These solutes cause the osmotic shift of water into the intestinal lumen to the extent of overwhelming the gut's ability to reabsorb it. Abnormal motility is generally seen in patients with chronic diarrhea but is always a component of acute diarrhea. Hypermotility decreases contact time between luminal contents and the absorbing mucosa, thereby limiting water and electrolyte absorption.

**28.3.** An otherwise healthy 25-year-old man presents with a 3-day history of diarrhea. He reports associated anorexia, weight loss, shortness of breath, and itching. On physical examination, he is noted to have diffuse erythematous wheals on his skin, and pulmonary examination reveals

bilateral wheezing. Of the following, which is the most likely cause of his diarrhea?

- A. *Bacillus cereus*
- B. Enteric adenovirus
- C. *Giardia lamblia*
- D. Rotavirus
- E. *Vibrio vulnificus*

**Answer: C.** Hives and bronchospasm in this patient point to excessive histamine release. In the setting of diarrhea, histamine release would most likely result from a parasitic infection. This is not common; however, it should be considered in patients presenting with diarrhea and histamine-induced skin changes. Of the choices listed, *Giardia lamblia* is the only parasite.

**28.4.** Evaluation of stool for ova and parasites would prove least beneficial in which of the following subsets of patients presenting with diarrhea?

- A. Patients concurrently taking clindamycin
- B. Patients returning from a trip to Russia
- C. Patients with chronic diarrhea
- D. Patients with human immunodeficiency virus (HIV) infection
- E. Patients working in daycare centers

**Answer: A.** The assessment of stool for ova and parasites is not routinely recommended in most cases of diarrheal illness. This study is used in patients with chronic diarrhea (*Entamoeba histolytica* and *Cryptosporidium*); patients with a history of travel to developing countries, particularly to Nepal or areas of Russia (*Cryptosporidium*, *Giardia*, and *Cyclospora*); patients with exposure to infants in daycare centers (*Cryptosporidium* and *Giardia*); and patients with HIV infection (*E. histolytica* and *Giardia*). Patients with diarrhea who are concurrently taking clindamycin would benefit most from testing for *Clostridium difficile* toxin.

**28.5.** Which of the following antibiotics is recommended for the empirical treatment of systemically ill-appearing adults with diarrhea?

- A. Azithromycin
- B. Ciprofloxacin
- C. Metronidazole
- D. Trimethoprim-sulfamethoxazole
- E. Vancomycin

**Answer: B.** The current recommendation for empirical treatment of a systemically ill-appearing adult is ciprofloxacin 500 mg orally twice a day or levofloxacin 500 mg orally every 24 hours for 3 to 5 days. Fluoroquinolones are efficacious against most organisms

that cause dysenteric illnesses and have been shown to be more effective than trimethoprim-sulfamethoxazole. Fluoroquinolones should not be administered to pregnant patients or children younger than 18 years old.

- 28.6. Which of the following causes of diarrhea is more common among children who attend daycare than among those who do not?
- A. *Campylobacter*
  - B. *Escherichia coli*
  - C. *Salmonella*
  - D. *Shigella*
  - E. *Yersinia*

**Answer: D.** Daycare attendance increases the probability of a patient having non-benign diarrhea caused by *Shigella*, *Giardia*, or rotavirus.

- 28.7. Homosexual men are at increased risk of diarrhea caused by which of the following protozoal pathogens?
- A. *Blastocystis hominis*
  - B. *Cryptosporidium*

- C. *Giardia lamblia*
- D. *Isospora belli*
- E. *Microsporidia*

**Answer: C.** Homosexual men have increased probability of complicated protozoal diarrhea syndromes caused by *Giardia lamblia* and *Entamoeba histolytica*.

- 28.8. Compared with the general population, diarrheal illnesses in organ transplant patients are more frequently caused by which of the following?
- A. Coronavirus
  - B. *Cytomegalovirus*
  - C. Herpes simplex virus
  - D. Norwalk virus
  - E. Rotavirus

**Answer: B.** Patients with organ transplants are at increased risk for complicated diarrhea caused by *Cytomegalovirus*.



## KEY CONCEPTS

- Constipation is a common patient concern and rarely has an emergent condition associated with it.
- Evaluation of the patient with constipation requires a detailed history (with particular attention to medication history), physical examination (including rectal examination) and rarely requires labs or imaging.
- Treatment of constipation includes addressing underlying etiologies and recommending the correct agent based on the etiology.
- Stool softeners (docusate sodium), although commonly prescribed, are ineffective and are rarely indicated.
- Osmotic agents or stimulants can be used to treat the majority of patients who present with constipation.
- Patients who have a large amount of stool in the rectum can be treated with an enema, which acts by distending the rectum and helps soften the stool to facilitate passage. For some with particularly recalcitrant stool, manual disimpaction may be required.
- Plain abdominal radiographs are of little or no use in diagnosing constipation or other, more serious abdominal disorders that may present as constipation, and should be used highly selectively, if at all.
- Patients with opioid-induced constipation that is refractory to other standard laxatives, may benefit from peripherally acting  $\mu$ -opioid receptor antagonists.

## CHAPTER 29: QUESTIONS &amp; ANSWERS

**29.1.** Which of the following statements regarding constipation is correct?

- A. Chronic constipation is defined as the presence of symptoms for at least 2 weeks.
- B. Constipation is a disease is increasing in frequency.
- C. Constipation is more common in men than in women.
- D. Obstipation refers to severe constipation with constant pain.
- E. The incidence of constipation is lower in patients with a high body mass index.

**Answer: D.** Obstipation refers to constipation has become severe with constant pain. Obstipation represents the progression of symptoms toward bowel obstruction. Constipation is a symptom, not a disease. Chronic constipation is defined as the presence of symptoms for at least 3 months. Constipation is more common in women than in men, those with higher body mass index, and in elderly patients.

**29.2.** A previously healthy, 50-year-old woman presents with a 1-day history of constipation associated with hard stools and increased straining. The physical examination (including rectal examination) is normal. Which of the following is the most appropriate next step in the evaluation and management of this patient?

- A. Laboratory evaluation of serum electrolytes
- B. Obtain abdominal radiograph series
- C. Obtain urinalysis
- D. Order colonic transit studies
- E. Prescribe a laxative agent

**Answer: E.** The majority of patients who present with a chief complaint of constipation do not need testing. Patients with acute constipation for which a cause is not readily apparent should be treated symptomatically and referred for outpatient evaluation and reassessment if needed.

**29.3.** Which of the following medications is the most likely cause of constipation in a patient with an otherwise non-concerning history and physical examination?

- A. Acetaminophen
- B. Albuterol
- C. Famotidine
- D. Hydrocodone
- E. Naproxen

**Answer: D.** Opioids are the most common class of medications to cause constipation. The other medications listed do not commonly cause constipation as a side effect.

**29.4.** A 25-year-old human immunodeficiency virus (HIV)-positive man presents with a 3-day history of constipation. He also reports a perianal mass has been slowly increasing in size during the past 3 months and has become painful in the past week. He has no other complaints. Physical examination reveals perianal condyloma acuminata with one area of tenderness, friability, and erosion. There is no evidence of infection, and stool can be palpated in the rectal vault during digital examination. Which of the following oral agents would be most beneficial for the symptomatic improvement of constipation in this patient?

- A. Docusate sodium
- B. Mineral oil
- C. Psyllium
- D. Senna
- E. Sorbitol

**Answer: B.** Oral mineral oil lubricants are particularly helpful in patients who have acute painful perianal lesions. The softening and coating of the stool can make passage much easier and less painful. Although not listed as an option, another consideration in this patient would be suppositories, which are especially helpful in patients who tend to have trouble expelling soft stool from the rectum. Glycerin suppositories may have a soothing effect and be helpful in patients with constipation caused by local, painful perianal lesions.

**29.5.** Which of the following agents used in the treatment of constipation is contraindicated in patients who are at increased risk for aspiration?

- A. Magnesium citrate
- B. Mineral oil
- C. Polyethylene glycol
- D. Psyllium
- E. Senna

**Answer: B.** Mineral oil is contraindicated in patients with swallowing problems or patients particularly debilitated who are at increased risk for aspiration, because this could ultimately lead to lipid pneumonia if aspirated.

## KEY CONCEPTS

- Acute pelvic pain in women is often from a gynecologic source, but urinary and intraabdominal sources are also common. Less frequently, the pain may arise from vascular, musculoskeletal, neurologic, or psychiatric sources.
- Potentially lethal diagnoses associated with acute pelvic pain include ectopic pregnancy, ovarian cyst with significant hemorrhage, and domestic violence; highly morbid conditions presenting with acute pelvic pain include pelvic inflammatory disease and ovarian torsion.
- Nearly all women of childbearing age with pelvic pain should have a pregnancy test performed, and most also require a pelvic ultrasound examination.
- Ectopic pregnancy should be excluded in the pregnant patient with pelvic pain. Bedside ultrasound is an excellent test for confirming an intrauterine pregnancy (IUP); it excludes ectopic pregnancy with a high degree of certainty in patients who are not undergoing assisted reproduction.
- In the nonpregnant patient, the pain of PID generally begins gradually and during menses. Ovarian cyst–associated pain is maximal at midcycle, and is usually gradual and cyclic, although it may be sudden and severe if rupture has occurred.
- Pregnant patients with acute pelvic pain may also have non–pregnancy-related disorders; appendicitis, nephrolithiasis, and ovarian torsion remain in the differential diagnosis.
- Many patients with acute pelvic pain require imaging as part of their assessment. If a gynecologic source is suspected, begin with an ultrasound and then progress to CT or MRI, if needed. The presence of an ovarian cyst on imaging does not necessarily explain the patient's pain, and further evaluation may be required.

## CHAPTER 30: QUESTIONS &amp; ANSWERS

**30.1.** Which of the following is most true regarding the evaluation of patients with pelvic pain?

- A. Ancillary testing can be limited to a urine pregnancy test in most patients.
- B. Bimanual examinations have been shown to result in highly reliable findings, with substantial interobserver agreement.
- C. Patients typically localize visceral pain with a high degree of accuracy.
- D. Thorough history taking is adequate to exclude most life-threatening conditions.
- E. None of these.

**Answer: E.** It is rare that any particular finding on history or physical examination is reliable enough to make or exclude a particular diagnosis conclusively in patients presenting with pelvic pain, so ancillary testing (beyond a simple pregnancy test) is commonly required in the evaluation of these patients. The bimanual examination may, at times, provide important information. Unfortunately, however, findings on pelvic examination are somewhat subjective and unreliable and may serve more to localize the process to one side or the other rather than diagnose it or even limit it to the reproductive organs. Although pelvic pain often originates from the reproductive organs, it may arise from any structures that lie adjacent to or course through the pelvis. Visceral pain afferents supplying the pelvic organs have common innervation with the appendix, ureters, and colon. Their significant overlap makes accurate localization difficult for both patient and emergency clinician.

**30.2.** A 26-year-old patient presents with right lower quadrant (RLQ) abdominal pain. She states her last menstrual period was 8 weeks ago. Bimanual pelvic examination reveals tenderness in the RLQ and right adnexal area. The patient's vital signs include a regular pulse of 120 beats/min and a blood pressure of 110/68 mm Hg. Urinalysis is unremarkable, and the urine pregnancy test is positive. What is the most appropriate next test?

- A. Cervical cultures
- B. Complete blood count (CBC)
- C. Computed tomography (CT)
- D. Magnetic resonance imaging (MRI)
- E. Pelvic ultrasonography

**Answer: E.** This follows the algorithms in Figs. 30.1 and 30.2. The most life-threatening pathology requiring urgent or emergent

intervention is hemorrhage from a ruptured ectopic pregnancy. A pelvic ultrasound scan is rapid, especially when using bedside ultrasonography, and is the first step in an evaluation of a suspected ruptured ectopic pregnancy.

**30.3.** A 30-year-old woman presents with lower abdominal pain. She has lower abdominal, uterine, bilateral adnexal, and cervical motion tenderness on pelvic examination. She has a negative urine pregnancy test and urinalysis. What is the most appropriate next step in the patient's management?

- A. Await cervical culture results.
- B. Obtain a CBC.
- C. Obtain a CT scan.
- D. Perform a pelvic ultrasound.
- E. Treat with antibiotics.

**Answer: E.** The constellation of uterine tenderness, bilateral adnexal tenderness, and cervical motion tenderness is classically associated with pelvic inflammatory disease (PID), particularly when the pain onset is during or just after menstruation. The diagnosis may be made, however, without the presence of all three signs, and treatment may be initiated with only one sign in an at-risk patient, as given in the 2015 Centers for Disease Control and Prevention (CDC) guidelines.

**30.4.** A 35-year-old woman undergoing infertility treatment presents with severe lower left quadrant (LLQ) abdominal pain and tenderness isolated to the left adnexal area on pelvic examination. The urine pregnancy test is positive, and the urinalysis is unremarkable. Rapid bedside ultrasonography reveals an intrauterine pregnancy with a gestational age of 6 weeks, 5 days, and moderate free pelvic fluid. Which diagnoses should be further investigated at this time?

- A. Ectopic pregnancy
- B. Heterotopic pregnancy
- C. Round ligament pain
- D. Simple ovarian cyst
- E. None of these

**Answer: B.** Women who are actively undergoing infertility treatment are at increased risk for ectopic pregnancy, heterotopic pregnancy, ovarian torsion, and ovarian hyperstimulation syndrome.

## KEY CONCEPTS

- Pregnancy status is the single most important determination to make when evaluating a woman with vaginal bleeding.
- There are many causes of abnormal bleeding in nonpregnant patients. Most nonpregnant patients presenting to the ED with vaginal bleeding can be safely discharged home, with timely gynecology follow-up.
- The use of the term *dysfunctional uterine bleeding* is no longer recommended; instead, use the term *abnormal uterine bleeding*.
- Hormonal and nonhormonal treatments can be initiated in the ED to temporize an acute bleeding episode in a nonpregnant patient until she can follow up with her gynecologist.
- Vaginal bleeding is common in early pregnancy. Most patients will be diagnosed with threatened miscarriage, but ectopic pregnancy should always be considered at any level of serum  $\beta$ -hCG.
- Vaginal bleeding after the 20<sup>th</sup> week of pregnancy is less common and is often associated with significant morbidity and mortality for the mother and fetus. These patients should be managed in close consultation with an obstetrician.

## CHAPTER 31: QUESTIONS &amp; ANSWERS

31.1. What is the leading obstetric cause of maternal mortality?

- A. Domestic violence
- B. Ectopic pregnancy
- C. Placental abruption
- D. Postpartum hemorrhage
- E. Septic abortion

**Answer: D.** Postpartum hemorrhage is the leading cause of maternal mortality. Within the first 24 hours after delivery, this is usually caused by uterine atony. After 24 hours, the cause is frequently retained products of conception.

31.2. A 30-year-old woman in the eighth week of her first gestation reports a 1-day history of crampy lower abdominal pain and scant vaginal bleeding. Vaginal examination reveals a minimal amount of dark blood oozing through a closed cervical os. Endovaginal ultrasonography confirms an intrauterine pregnancy of 8 weeks' gestation. The fetus has good cardiac activity. What is the most appropriate diagnosis for this patient?

- A. Incomplete abortion
- B. Inevitable abortion
- C. Missed abortion
- D. Normal pregnancy
- E. Threatened abortion

**Answer: E.** Bleeding during pregnancy is common but should not be considered normal. The symptoms and findings in this patient lead to a diagnosis of threatened abortion, which is described as

bleeding of intrauterine origin before the completion of 20 weeks' gestation, without dilation of the cervix, and without expulsion of products of conception. Patients with threatened abortion may or may not have uterine contractions. An incomplete abortion is the expulsion of some, but not all of the products of conception, which would be a complete abortion, before the completion of 20 weeks' gestation. An inevitable abortion is defined as bleeding of intrauterine origin before the completion of 20 weeks' gestation, with dilation of the cervical os but without expulsion of THE products of conception. Missed abortion refers to retained products of conception after demise of the embryo or fetus.

31.3. A 30-year-old woman who is 26 weeks pregnant describes a 1-hour history of painless vaginal bleeding after tripping and falling from a standing height. Her vital signs are normal, and physical examination of the abdomen reveals a nontender uterus with a fundal height 1 cm above the umbilicus. Of the following, which would be the most appropriate next step in evaluating this patient?

- A. Abdominal MRI
- B. Bimanual examination
- C. Sterile speculum examination
- D. Ultrasound

**Answer: D.** Painless vaginal bleeding after the 20th week of pregnancy is suggestive of placenta previa. Pelvic examination (speculum or bimanual) should be deferred until ultrasound has excluded placenta previa as the cause of bleeding.

## KEY CONCEPTS

- Acute low back pain is a common, costly, recurring, and painful condition that often has no recognizable or dangerous cause. Most low back pain is nonspecific and improves without laboratory evaluation or imaging.
- The vast majority of patients can be properly managed by their PCP and do not require ED consultation or specialty referral.
- A focused history should be elicited from patients with lower back pain, with the goal of uncovering high-risk features that would predispose the patient to an emergent or life-threatening situation. The physical examination should focus on the lower extremity neurologic examination, including testing of strength, sensation, and reflexes.
- Imaging and laboratory studies are rarely indicated following the history and physical examination and are only indicated when there is evidence of neurologic deficit or multiple key clinical findings suggesting a dangerous or systemic pathologic cause.
- Adherence to published guidelines will decrease the use of improper laboratory studies and imaging, thereby lowering costs, reducing ED throughput, and improving overall patient care.
- MRI in the ED should only be ordered when there is strong consideration of a serious or progressive neurologic lesion or spinal infection. When a critical or emergent diagnosis is strongly suspected, MRI and spine surgery consultation should be undertaken emergently.
- Patients who have low back pain emergencies are generally classified in two five groups: (1) past medical history of malignancy and new back pain, with neurologic findings; (2) back pain and symptoms of epidural compression syndrome; (3) back pain with symptoms suggesting an infectious cause; (4) back pain with gross muscle weakness or paralysis; and (5) back pain and bilateral or multiple nerve root involvement.

## CHAPTER 32: QUESTIONS &amp; ANSWERS

**32.1.** What would be the most likely cause of back pain in a 48-year-old patient with bilateral leg pain and weakness, urinary retention, decreased rectal tone, and saddle anesthesia?

- A. Abdominal aortic aneurysm
- B. Bone metastasis
- C. Epidural abscess
- D. Herniated disk
- E. Primary bone tumor

**Answer: D.** The listed symptoms and signs describe cauda equina syndrome, which is usually caused by a large central herniated disk. Other less common causes include tumor and infection.

**32.2.** What percentage of herniated disks regress or completely resolve over 6 months?

- A. 5%
- B. 33%
- C. 50%
- D. 66%
- E. 90%

**Answer: D.** Serial magnetic resonance imaging (MRI) studies have shown that 66% of herniated disks regress or resolve over 6 months. This high percentage argues for early conservative therapy and argues against early MRI or computed tomography (CT) imaging.

**32.3.** A 35-year-old man presents with severe back pain that radiates down his right leg. He reports that while lifting a heavy box at work 2 weeks ago, he felt a “pop” in his lower back. He has not been able to return to work since the injury occurred. The patient spoke with his lawyer and was told to come directly to the emergency department to get an MRI. He denies having any other symptoms and reports no significant past medical history. During the physical examination, the patient is asked to lie on his back, with his knees extended. His right leg is elevated and, at 50 degrees, he reports severe pain running down the lateral aspect of his right leg to his foot. The patient is then asked to sit with his knees flexed and legs hanging over the side of the bed. His legs are passively extended, with no production of pain. The remainder of the physical examination is normal. What is the most appropriate next step in managing this patient?

- A. CT of the lumbar spine
- B. Discharge home
- C. Emergent neurosurgical consultation
- D. MRI of the lumbar spine
- E. Radiography of the lumbar spine

**Answer: B.** Several aspects of this scenario point to malingering. The most convincing relates to the physical examination findings. The straight leg raise (SLR) is the classic test for sciatic nerve root irritation. The absence of a positive result generally rules out nerve root irritation. To perform the SLR, the patient is positioned supine, knee extended, and leg elevated until pain is elicited. A positive result is pain radiating down the leg below the knee in a dermatomal distribution when the leg is elevated between 30 and 70 degrees. In a patient who may be malingering, the SLR can be performed with the patient sitting on the side of the bed with knees flexed. Passively straightening the legs in this position should produce equally positive results if true nerve root irritation exists.

**32.4.** Disk herniation with involvement of the L5 nerve root will present with which of the following findings?

- A. Decreased or absent ankle jerk
- B. Decreased patellar reflex
- C. Diminished sensation of the lateral small toe
- D. Impaired plantar flexion
- E. Weakness with extension of the great toe

**Answer: E.** Involvement of the L5 nerve root presents with weakness, with extension of the great toe, decreased sensation in the first web space, and normal reflexes. An S1 radiculopathy is characterized by diminished sensation of the lateral small toe, impaired plantar flexion, and decreased or absent ankle jerk. The patellar reflex is associated with L2-4.

**32.5.** A history of intravenous (IV) drug use increases the risk for which of the following causes of acute back pain?

- A. Abdominal aortic aneurysm
- B. Epidural hematoma
- C. Malignancy
- D. Transverse myelitis
- E. Vertebral osteomyelitis

**Answer: E.** Vertebral osteomyelitis and spinal epidural abscess are diagnosed most frequently in an at-risk population that includes patients with a history of diabetes, chronic renal failure, IV drug use, alcoholism, cancer, AND recent surgery or trauma.

**32.6.** Plain films have the highest utility in diagnosing which of the following?

- A. Abdominal aortic aneurysm
- B. Epidural hematoma
- C. Spinal stenosis
- D. Transverse myelitis
- E. Vertebral osteomyelitis

**Answer: E.** Plain films are diagnostic in 80% to 95% of cases of vertebral osteomyelitis. There is limited usefulness with any of the other conditions listed.

**32.7.** Spinal epidural abscess is most commonly caused by which of the following pathogens?

- A. *Mycobacterium tuberculosis*
- B. *Pseudomonas aeruginosa*
- C. *Staphylococcus aureus*
- D. *Staphylococcus epidermidis*
- E. *Streptococcus pyogenes*

**Answer: C.** *S. aureus* causes 70% of spinal epidural abscesses.



## KEY CONCEPTS

- Immediately after a trauma patient arrives in the ED, the primary survey should be performed in a standardized fashion. The goal of the primary survey is to identify and initiate the treatment of critical, life-threatening injuries rapidly.
- The eFAST examination should take place early in the evaluation of the trauma patient, ideally as part of the primary survey. Thoracic examination of the trauma patient by ultrasound is more accurate than plain radiography.
- Any patient with potentially life-threatening injuries should have blood typing and screening performed. When transfusion is indicated, blood products should be transfused in a 1:1:1 or 1:1:2 ratio of plasma to platelets to packed red blood cells.
- Tranexamic acid is indicated for patients with evidence of significant hemorrhage or shock and is given as a 1-g bolus followed by a 1-g infusion over 8 hours. Results are best if started within 1 hour of injury but benefit may occur when it is given within 3 hours.

## CHAPTER 33: QUESTIONS &amp; ANSWERS

- 33.1. A 33-year-old mother and her 2-year-old-son are brought in by paramedics after they were both hit by a car moving at 15 mph. Although mother and child had an identical mechanism of injury, the son would be at greater risk for all the following injuries, with the following exception:
- A. Head injury
  - B. Hypothermia
  - C. Intra-abdominal injury
  - D. Multisystem injury
  - E. Posttraumatic stress disorder

**Answer: E.** Injury patterns can differ significantly between adults and children subjected to similar mechanisms of trauma. The major anatomic distinctions relate to the smaller size and surface area, larger head-to-body ratio, and less protected abdominal cavity of the child. As a result, children are more vulnerable to multisystem injury in blunt trauma, including significant head and intra-abdominal injuries, as well as being at greater risk for hypothermia.

- 33.2. Which of the following is the goal of the primary survey?
- A. Determine which consultations should be obtained.
  - B. Do an AMPLE (allergies, medications, past medical history, last meal, environments and events) history.
  - C. Obtain pertinent historical data from the paramedics.
  - D. Perform a radiographic evaluation.
  - E. Rapidly identify critical life-threatening diagnoses and begin treatment at the time of the diagnosis.

**Answer: E.** The emergency clinician should use a standardized approach to the initial evaluation of these patients. Following the Advanced Trauma Life Support (ATLS) algorithm of ABCs in the primary survey allows the timely identification of critical diagnoses and intervention without delay. The primary survey should be performed in a standardized fashion immediately after the patient arrives in the emergency department. The goal of the primary survey is to identify critical, life-threatening diagnoses rapidly and begin treatment at the time of diagnosis. The goals of the secondary survey are to obtain pertinent historical data about the patient and injury as well as evaluate and treat injuries not found on the primary survey. An AMPLE history should be obtained.

- 33.3. An 89-year-old man who was a restrained front seat passenger with a history of hypertension, anxiety disorder, and dementia is being evaluated after a head-on collision. His home medications include an angiotensin-converting enzyme (ACE) inhibitor for the hypertension, lorazepam for the anxiety, and olanzapine (Zyprexa) for the dementia. The patient does not have any complaints but is noted to have a blood pressure of 80/50 mm Hg and heart rate of 100 beats/min. In evaluating the patient, you should suspect that the asymptomatic hypotension is most likely due to which of the following?
- A. Antihypertensive medication use
  - B. Antipsychotic medication use
  - C. Benzodiazepine use
  - D. Blood loss

**Answer: D.** Lower extremity weakness, gait disturbances, decreased visual acuity, and the use of psychotropics, antihypertensives, and sedatives have been associated with falls in older adults, resulting in major injury. The use of these medications, particularly antihypertensives, should not be considered causative in trauma patients with hypotension until acute hemorrhage has been ruled out. In addition, anticoagulants, antiplatelet drugs, and aspirin are commonly prescribed, and their effects should be suspected and reversed, if warranted.

- 33.4. A critically injured, multisystem trauma patient has blood sent to the laboratory. The appropriate tests may determine the adequacy of resuscitation and need for blood transfusion. Hypoperfusion and inadequate resuscitation may be indicated by abnormalities in all except which of the following?
- A. Anion gap
  - B. Base deficit
  - C. Central venous oxygen saturation
  - D. Lactate level
  - E. Magnesium

**Answer: E.** Laboratory markers can help identify patients who may not appear acutely ill but do have hypoperfusion, as well as track the adequacy of resuscitation. Lactate level, base deficit, and anion gap also predict outcome in the trauma patient. Following changes in the central venous oxygen saturation may also be worthwhile; low values in hemodynamically stabilized trauma patients have been shown to worsen outcome.

- 33.5. A severely injured, hypotensive trauma patient is being considered for permissive hypotension because she has a contained retroperitoneal hematoma and is not actively hemorrhaging. In permissive hypotension, the mean arterial pressure is restored to a goal of 50 mm Hg. Which of the following should help you decide against using permissive hypotension?
- A. Age > 80 years
  - B. Age < 10 years
  - C. Associated traumatic brain injury
  - D. Hemoglobin of 10 g/dL
  - E. Intoxication

**Answer: C.** In the severely injured, hypotensive trauma patient, restoration of normal blood pressure may be undesirable. The concept of permissive hypotension is based on the concern that resuscitation to normal blood pressures may increase bleeding from a site that is contained and not actively hemorrhaging. In permissive hypotension, the mean arterial pressure (MAP) is restored to a goal of about 50 mmHg. Studies have shown that this strategy leads to less blood product use, less bleeding, and lower incidence of coagulopathy. However, the provider should be aware that permissive hypotension is contraindicated in the management of traumatic brain injury because of the risk of hypoperfusion.

## KEY CONCEPTS

- *Head trauma* is a broad term describing an external trauma to the craniofacial area of the body from blunt, penetrating, blast, rotational, or acceleration-deceleration forces, the term *head injury* refers to a clinically evident injury on physical examination, and the term *brain injury* indicates an injury to the brain itself.
- TBI is often categorized into mild (GCS score, 13–15), moderate (GCS score, 9–12), and severe (GCS score, 3–8), but this actually represents a spectrum of injury. Patients with a presentation GCS score of 13 to 15 who are stable or improving are exceedingly unlikely to have CT findings that warrant intervention.

## Severe and Moderate Traumatic Brain Injuries

- Secondary systemic insults such as hypoxia and hypotension worsen neurologic outcome and should be corrected as soon as detected.
- Noncontrast head CT is the imaging modality of first choice when TBI is suspected.
- The motor component of the GCS is the strongest predictor of outcome following TBI.

## Penetrating Head Trauma

- Anticonvulsant prophylaxis with phenytoin and broad-spectrum antibiotics should be given to patients with penetrating brain injuries for 7 days postinjury.

## Mild Traumatic Brain Injury

- Patients can deteriorate from an expanding intracranial hematoma after what appears clinically to be MTBI, and should undergo serial evaluations, including serial GCS scoring.
- An MTBI can be easily overlooked when an alert patient presents with other more obvious traumatic injuries. Specifically, ask patients

about symptoms of disorientation, confusion, amnesia, or disordered awareness (with or without loss of consciousness).

- Imaging of patients in this population should follow a validated guideline, such as the Canadian CT Head Rule and New Orleans Criteria. Emergency clinicians should work collaboratively to select the system thought to be most applicable for their setting and patient population.
- Alcohol and drug use affects the GCS score and significantly obscures the neurologic examination. Intoxicated individuals are high-risk patients.
- Most patients with MTBI can be discharged from the ED with a normal examination and after a reasonable period of ED observation (4–6 hours) or following a negative head CT.
- Patients should be discharged with instructions describing the signs and symptoms of acute and delayed complications of MTBI. All discharge instructions should be written and relayed to a responsible third party.

## Special Populations

- Any athlete suspected of having a concussion should be immediately removed from play.
- Athletes with concussion should not return to play until they have been evaluated by a licensed health care provider with expertise in concussion management. There should be a gradual stepwise increase in physical activity.
- Older adults can have significant hemorrhage into their brain and not show signs of deterioration, especially if their baseline cognitive functioning is impaired. Patients older than 60 years should have a CT scan obtained.
- Falls in older adults, including low-mechanism falls, should prompt health care providers to consider the possibility of brain injury.

## CHAPTER 34: QUESTIONS &amp; ANSWERS

- 34.1. Injured brain ischemia may be seen with partial pressure of carbon dioxide ( $\text{PCO}_2$ ) levels below what value?
- 35 mm Hg
  - 30 mm Hg
  - 25 mm Hg
  - 20 mm Hg

**Answer: D.** Cerebral vasculature is exquisitely sensitive to  $\text{PCO}_2$  levels. The degree of vasoconstriction below a  $\text{PCO}_2$  of 20 mm Hg may be so severe as to induce ischemia. Modest hyperventilation to a target of 30 to 35 mm Hg is recommended once acute resuscitation is completed.

- 34.2. Which of the following statements is true regarding cerebral blood flow (CBF), cerebral perfusion pressure (CPP), and intracranial pressure (ICP)?
- CBF autoregulation is lost below a CPP of 60 mm Hg.
  - CPP closely parallels diastolic blood pressure.
  - Normal ICP is 65 to 195 mm Hg.
  - CPP = mean arterial pressure (MAP) – ICP.
  - The only resistance to CBF is ICP.

**Answer: D.** CBF depends on CPP, which is the blood flow pressure gradient. CBF resistance is provided by mean systemic venous pressures and ICP, predominantly by the latter. CPP closely parallels MAP offset by ICP; thus, the formula  $\text{CPP} = \text{MAP} - \text{ICP}$ . ICP is estimated clinically by the central venous pressure unless a ventricular catheter is in place and ICP can be directly determined. CBF autoregulation is lost below a CPP of 40 mm Hg. Normal ICP is 5 to 15 mm Hg or 65 to 195 mm  $\text{H}_2\text{O}$ .

- 34.3. Which of the following parameters are associated with a worsened outcome after traumatic brain injury (TBI)?
- Both D and E
  - Core body temperature  $> 37.5^\circ \text{C}$  ( $99.5^\circ \text{F}$ )
  - None of the above
  - Partial pressure of oxygen ( $\text{PO}_2$ )  $< 60$  mm Hg
  - Systolic blood pressure  $< 90$  mm Hg

**Answer: A.** The following are associated with worsened outcomes after TBI:

Hematocrit (Hct)  $< 30\%$   
 Temperature  $> 38.5^\circ \text{C}$  ( $101.3^\circ \text{F}$ )  
 Systemic blood pressure (SBP)  $< 90$  mm Hg  
 $\text{PO}_2 < 60$  mm Hg

- 34.4. A 27-year-old man presents after a motor vehicle collision (MVC) with a severe closed head trauma. On examination, you calculate a Glasgow Coma Scale (GCS) score of 5 and a left dilated pupil, with a sluggish pupillary reflex compared with the right. What other finding will your examination likely reveal?
- Left carotid bruit
  - Left foot weakness
  - Loss of controlled pain/temperature sensation
  - Right carotid bruit
  - Right-sided hemiparesis

**Answer: C.** Uncal herniation is the most common posttraumatic herniation syndrome. The initial pressure compresses the third cranial nerve (CN III), causing ipsilateral pupillary sluggishness, ptosis, anisocoria, and impaired extraocular movements. Contralateral hemiparesis can develop early after an initial normal motor examination. In some cases, the contralateral uncus is compressed, resulting in ipsilateral weakness (Kernohan notch syndrome).

- 34.5. A 24-year-old man presents with a closed head injury after a MVC. The physical examination is remarkable for a sluggish left pupil, right-sided hemiparesis, and a GCS score of 12. What should be the next step in this patient's management?
- A. 3% hypertonic saline IV
  - B. Intubation and hyperventilation
  - C. Mannitol, 1 g/kg IV
  - D. Methylprednisolone IV
  - E. Pentobarbital IV

**Answer: B.** The most rapid effect on ICP reduction is achieved via intubation and moderate hyperventilation to a  $P_{CO_2}$  of 30 to 35 mm Hg. The effect peaks within minutes and should be considered a short-term intervention, with an expected ICP reduction of 25%. Prolonged hyperventilation may be dangerous. Steroids may worsen outcome after TBI. Mannitol is generally efficacious and exerts an effect within minutes and lasts hours. Other neuroprotective effects include volume expansion, viscosity reduction, CBF improvement, and free radical scavenging. Hypertonic saline data are encouraging but inconclusive; stronger data exist in the pediatric literature. Barbiturates exert a modest ICP-lowering effect because of their lowering of the cerebral metabolic rate and oxygen demand.

- 34.6. What is the minimum time after becoming asymptomatic that an individual should refrain from playing sports after a concussion if no loss of consciousness (LOC) or prolonged posttraumatic amnesia occurred at the time of injury?
- A. 24 hours
  - B. 48 hours
  - C. 1 week
  - D. 2 weeks
  - E. 1 month

**Answer: C.** All current recommendations for return to play after a sports-related concussion state that players with concussion should not return to play for at least 1 week after they have become asymptomatic. This is usually increased to at least a symptom-free month for an extended LOC or prolonged posttraumatic amnesia occurring at the time of the concussion.

- 34.7. A 15-year-old boy presents after being hit in the head with a baseball. He has a GCS score of 7 and a large hematoma of his scalp, anterior and superior to his right ear. In addition, he is noted to have unequal pupils and a sluggish pupillary light reflex of the right eye. Which of the following is most likely in this patient?
- A. Central transtentorial herniation
  - B. Cerebellotonsillar herniation
  - C. Downward transtentorial herniation
  - D. Uncal herniation
  - E. Upward transtentorial herniation

**Answer: D.** Uncal herniation is often associated with traumatic extra-axial hematomas in the lateral middle fossa of the temporal lobe. The classic signs and symptoms are caused by compression of the ipsilateral uncus of the temporal lobe on the U-shaped edge of the tentorium cerebelli as the brain is forced through the tentorial hiatus. As compression of the uncus begins, CN III is compressed; anisocoria, ptosis, impaired extraocular movements, and a sluggish pupillary light reflex develop on the side ipsilateral to the expanding mass lesion. This phase may last for minutes to

hours, depending on how rapidly the expanding lesion is changing. As the herniation progresses, compression of the ipsilateral oculomotor nerve eventually causes ipsilateral pupillary dilation and nonreactivity.

Initially, in the uncal herniation process, the motor examination can be normal, but contralateral Babinski responses develop early. Contralateral hemiparesis develops as the ipsilateral peduncle is compressed against the tentorium. With continued progression of the herniation, bilateral decerebrate posturing eventually occurs; decorticate posturing is not always seen with the uncal herniation syndrome. In some patients, the contralateral cerebral peduncle is forced against the opposite edge of the tentorial hiatus. Hemiparesis is then detected ipsilateral to the dilated pupil and mass lesion, termed *Kernohan notch syndrome*, and causes false-localizing motor findings. As uncal herniation progresses, direct brainstem compression causes additional alterations in the LOC, respiratory pattern, and cardiovascular system. Mental status changes may initially be subtle, such as agitation, restlessness, or confusion, but soon lethargy occurs, with progression to frank coma. The patient's respiratory pattern may initially be normal, followed by sustained hyperventilation. With continued brainstem compression, an ataxic respiratory pattern develops. The patient's hemodynamic status may change, with rapid fluctuations in blood pressure and cardiac conduction. Herniation that is uncontrolled progresses rapidly to brainstem failure, cardiovascular collapse, and death.

- 34.8. Central pontine myelinolysis is a potential adverse event associated with the administration of which of the following medications?
- A. Etomidate
  - B. Hypertonic saline
  - C. Mannitol
  - D. Methylprednisolone
  - E. Pentobarbital

**Answer: B.** Central pontine myelinolysis is a potentially adverse event associated with hypertonic saline administration.

## KEY CONCEPTS

The face is central to the patient's ability to breathe, eat, and communicate. Injuries to the face can have serious psychological and psychosocial consequences.

- Facial injuries may be prevented by the appropriate use of seat belts, child restraints, air bags, helmets, and mouth and face guards.
- The epidemiology of facial injury is changing, with an increasing proportion of injuries occurring as a result of interpersonal violence. A careful history is required, and the possibility of abuse should be considered for every patient.
- Shock from facial trauma is rare and results only from obvious external bleeding. Facial injuries should not distract the emergency clinician from aggressively searching for other causes of shock.
- Assertive management of the airway is indicated in a patient with significant facial injuries. Surgical management (cricothyroidotomy) may be required, particularly with gunshot wounds.
- Directed facial CT scanning is the best imaging technique in patients with obvious injuries.
- Definitive treatment may be delayed, if necessary, to allow other serious injuries to be addressed.

## CHAPTER 35: QUESTIONS &amp; ANSWERS

35.1. Stensen's duct enters the mouth most closely to which tooth?

- A. First lower molar
- B. First upper molar
- C. First upper premolar
- D. Second lower molar
- E. Second upper molar

**Answer: E.** The salivary system consists of the parotid, sublingual, and submandibular glands. The parotid is the largest of these glands, lying just anterior to the ear and wrapping around the mandible. The parotid is superficial to the masseter muscle and drains via Stensen's duct, a 5-cm tube that curves around the anterior edge of the masseter to enter the mouth opposite the second upper molar. The sublingual glands lie entirely within the floor of the mouth and drain into the mouth via ductules. They surround the ducts draining the submandibular glands (Wharton's ducts). The body of the submandibular gland is folded around the mylohyoid muscle so that a portion lies within the floor of the mouth and a portion lies external to it. The submandibular (Wharton's) ducts run from the external portion of the gland to empty into the mouth on either side of the frenulum of the tongue.

35.2. Which term is used to describe bilateral transverse fractures through the maxilla above the roots of the teeth?

- A. Craniofacial disjunction
- B. Le Fort I fracture
- C. Le Fort II fracture
- D. Le Fort III fracture
- E. Trimalar fracture

**Answer: B.** Tripod (or trimalar) fractures are among the simplest fractures of the midface and include fractures of three bones—the lateral orbit, zygoma, and maxilla. More complex fractures of the midface are classified using the Le Fort system, although many

complex fractures defy classification with this system. A Le Fort I fracture involves a transverse fracture through the maxilla above the roots of the teeth and may be unilateral or bilateral. Patients may complain of malocclusion, and the maxilla may be mobile when the upper teeth are grasped and rocked. A Le Fort II fracture is typically bilateral and pyramidal in shape. It extends superiorly in the midface to include the fracture of the nasal bridge, maxilla, lacrimal bones, orbital floor, and rim. In these cases, the nasal complex moves as a unit with the maxilla when the teeth are grasped and rocked. Le Fort III fractures involve fracturing the connections between the elements of the skull and face (craniofacial disjunction). These fractures start at the bridge of the nose and extend posteriorly along the medial wall of the orbit (ethmoid), along the floor of the orbit (maxilla) and through the lateral orbital wall, and finally break through the zygomatic arch. Intranasally, they extend through all the lesser bones to the base of the sphenoid and frequently are associated with a cerebrospinal fluid (CSF) leak.

35.3. Treatment for a patient with a blowout fracture can include all the following recommendations except which one?

- A. Application of cold compress to reduce swelling
- B. Appropriate oral antibiotic
- C. Discouraging nose blowing to avoid creating or exacerbating any orbital emphysema
- D. Use of decongestants to help keep the sinuses clear of any draining fluid
- E. Use of steroid eye drops to help decrease any inflammation in the affected eye

**Answer: A.** The use of steroid eye drops should not be initiated by the emergency clinician for a blowout fracture. Antibiotic prophylaxis against the potential sequelae of sinusitis, orbital cellulitis, and other more malignant intracranial infections is appropriate, as would be the use of decongestants and the avoidance of any activities that would exacerbate orbital emphysema.



## KEY CONCEPTS

- The anterior cord syndrome, characterized by paralysis and hypalgesia below the level of injury, with preservation of position, touch, and vibration, results from hyperflexion injuries causing cord contusion, by the protrusion of a bony fragment or herniated disk into the spinal canal, or by laceration or thrombosis of the anterior spinal artery. Suspicion for an anterior cord syndrome warrants prompt neurosurgical consultation because it is a potentially surgically correctable lesion.
  - In the awake, evaluable trauma patient, the NEXUS or CCR decision rules may be used to determine the need for radiographic imaging.
  - In the awake, evaluable trauma patient, unless the patient has a very minor trauma mechanism (or CT is not available), CT is preferred over plain radiography, especially if CT is being performed on other body parts.
  - Neurogenic hypotension, caused by loss of vasomotor tone and lack of reflex tachycardia, is a diagnosis of exclusion in the trauma victim.
- It should not be considered the cause of hypotension unless the patient is flaccid and areflexic, reflex tachycardia and peripheral vasoconstriction are absent and, most importantly, the possibilities of coexisting hemorrhagic shock, cardiac tamponade, or tension pneumothorax have been eliminated.
- Because neurogenic hypotension can lead to hypoperfusion and secondary spinal cord ischemia, prolonged, severe hypotension (systolic blood pressure < 70 mm Hg) should be prevented and treated. When there is persistent hypotension despite fluid resuscitation, we recommend vasopressor support with norepinephrine to be started at 0.05 µg/kg/min and titrated upward to a maximum dose of 1 µg/kg/min to achieve an MAP of 85 mm Hg.
  - Methylprednisolone or any other steroid is not beneficial in the treatment of acute spinal cord injury and should not be used.
  - Emergency department management of SCI includes care to prevent pressure ulcers, bladder distention, and gastric distention.

## CHAPTER 36: QUESTIONS &amp; ANSWERS

- 36.1. Which of the following is a stable cervical spine fracture?
- Anterior atlantoaxial dislocation without fracture
  - Bilateral facet dislocation
  - Flexion teardrop
  - Jefferson fracture
  - Unilateral facet dislocation

**Answer: E.** See [Table 36.1](#) for a classification of spinal injuries according to stability.

- 36.2. A 28-year-old man is brought to the emergency department (ED) after a rollover motor vehicle collision (MVC). He is moderately hypotensive, unable to flex his elbows, and has diffuse lower extremity paralysis. What is the likely site of the lesion?
- C4
  - C5
  - C6
  - C7
  - C8

**Answer: C.** See [Table 36.2](#).

- 36.3. Which of the following statements regarding high-dose methylprednisolone after spinal cord injury is true?
- Dexamethasone is superior to methylprednisolone if a concurrent closed head injury is present.
  - High-dose methylprednisolone should not be used to treat spinal cord injury.
  - It is efficacious after penetrating injury if given within 4 hours.
  - It is efficacious in cases of spinal shock.
  - It is more efficacious after thoracic than after lumbar injuries.

**Answer: B.** Evidence that high-dose methylprednisolone is a clinically efficacious intervention in the management of acute, blunt, partial spinal cord injury is lacking and, because of severe side effects, should not be used.

- 36.4. A 27-year-old man presents after a high-speed rollover MVC. The physical examination is remarkable for T8 motor-sensory deficit and a moderately distended abdomen that is nontender. Vital signs are heart rate, 108 beats/min, blood pressure, 88/40 mm Hg, respiratory rate, 22 breaths/min, temperature, 35° C (95° F), and oxygen (O<sub>2</sub>) saturation, 96%. Which of the following tests or treatments is indicated?
- Baseline laboratory tests and observation
  - Computed tomography (CT) scan of the abdomen
  - Intravenous phenylephrine infusion
  - Packed red blood cell transfusion
  - Thoracolumbar spine films

**Answer: B.** Spinal cord injury often renders the abdominal examination unremarkable. CT, ultrasonography, diagnostic peritoneal lavage, or some combination is necessary to rule out intra-abdominal injury.

- 36.5. A 23-year-old man presents after a rollover MVC. He is brought by emergency medical services (EMS) from the scene fully restrained on a backboard, with a cervical collar. The physical examination is remarkable for moderate symmetric numbness below the neck, symmetric arm and leg weakness, intact reflexes, and diminished rectal tone. Vital signs are heart rate, 94 beats/min, blood pressure, 80/46 mm Hg, respiratory rate, 24 breaths/min, and O<sub>2</sub> saturation, 96%. Which of the following treatment sequences is most indicated?
- Crystalloid to CT scan to phenylephrine
  - Crystalloid to focused assessment with sonography for trauma (FAST) examination to transfusion
  - Crystalloid to phenylephrine to transfusion
  - Dopamine to crystalloid to CT scan
  - Transfusion to phenylephrine

**Answer: B.** Spinal shock should not be considered the cause of hypotension unless the patient is flaccid and areflexic. Crystalloid is the first step regardless of the traumatic hypotensive cause. The possibilities of coexisting hemorrhagic shock, cardiac tamponade, tension pneumothorax, or other life-threatening injuries should first be addressed. The absence of vasomotor activity in patients with neurogenic hypotension may mask the usual presentation of these life-threatening injuries. In this case, the lack of flaccidity and presence of reflexes argues for a nonneurogenic cause for the hypotension.



## KEY CONCEPTS

- Neck trauma results from three major mechanisms: blunt injury, penetrating injury, or near hanging or strangulation. Platysma violation defines a penetrating injury.
- The external neck is divided into zones I, II, and III. Zone designation has anatomic, diagnostic, and management implications in penetrating trauma, but use of computed tomography angiography (CTA) has greatly simplified the approach to the evaluation. Many injuries involve more than one zone.
- Zone I and III respectively encompass the thoracic inlet and base of skull, and penetrating injuries to these regions risk more occult vascular injury.
- Airway stabilization is the first priority in neck trauma. In most instances, flexible endoscopy is preferred, if possible, but orotracheal rapid sequence intubation (RSI), using a double set-up is also a valid approach. A surgical airway option should be available.
- Cervical spine injury in penetrating neck trauma without neurological deficits is extremely rare.
- Esophageal injuries are uncommon but represent the most frequently missed neck injury. Delays in diagnosis carry an extremely high mortality.
- Hard signs of vascular injury following penetrating trauma include rapidly expanding or pulsatile hematoma, massive hemoptysis, severe hemorrhage, shock not responding to fluids, decreased or absent pulse, vascular bruit or thrill, respiratory distress, and/or cerebral ischemia. Hard signs of aerodigestive injury include air bubbling from wound or extensive subcutaneous emphysema. Typically, patients with hard signs require prompt surgical intervention.
- Blunt vascular injuries are often asymptomatic but can present with immediate or delayed neurological sequelae. Cerebral ischemia, aphasia, dysphagia, Horner syndrome, ataxia, vertigo, visual field defects, and emesis should prompt consideration of anterior or posterior circulation vascular injury.
- Seat-belt signs should be differentiated from neck hematomas (the latter being of greater concern). The literature does not support an isolated cervical seat-belt sign as a sign of vascular injury.
- CTA is more than 90% sensitive for the detection of vascular injury with penetrating neck trauma but less sensitive for identifying vascular injury in blunt trauma. Digital subtraction angiography (DSA) is indicated for patients with high pre-test probability of injury but a normal CTA.
- A leading cause of in-hospital death following near-hanging or strangulation are pulmonary complications, including pulmonary edema, which has three primary etiologies: postobstructive, neurogenic, and cardiac.

## CHAPTER 37: QUESTIONS &amp; ANSWERS

37.1. The presence of which of the following signs after penetrating neck trauma would indicate a likely benefit from surgical intervention?

- A. Decreased or absent radial pulse
- B. Small degree of hemoptysis
- C. Horner syndrome
- D. Muffled voice
- E. Stable hematoma

**Answer: A.** “Hard” signs of penetrating neck trauma are the presence of an expanding hematoma, severe active bleeding, shock not responding to fluids, decreased/absent radial pulse, vascular bruit/thrill, cerebral ischemia, and airway obstruction. Most patients with hard signs benefit from surgical intervention.

37.2. Which of the following statements regarding airway management after penetrating neck trauma is true?

- A. Awake fiberoptic intubation is the first-line technique.
- B. Bag-valve-mask ventilation should be high tidal volume, low rate.
- C. Cervical spine immobilization is typically unnecessary.
- D. Nasotracheal intubation position is relatively contraindicated in neck trauma.
- E. Preintubation nasogastric tube (NGT) placement may be lifesaving.

**Answer: C.** Unless there is concomitant blunt injury or evidence of spinal cord injury, cervical immobilization is not needed. Classic oral intubation after rapid sequence intubation (RSI) is the technique of choice and is successful in almost all cases. Although rarely a first line choice, nasotracheal intubation has been used successfully in these trauma patients. Gentle

bag-valve-mask technique with low pressures is indicated to avoid venous air embolism (VAE) and subcutaneous emphysema. NGT placement, if done at all, should be gentle and placed after intubation.

37.3. A 21-year-old male presents after a small-caliber gunshot wound (GSW) to the left neck. He is hypotensive, hypoxic, and lethargic, but physical examination is remarkable only for a small zone I penetrating wound on the left side, with no gross swelling or crepitus. Oral intubation and rapid crystalloid infusion fail to improve his blood pressure (BP) or oxygen saturation. A portable chest radiograph is negative. While still in the emergency department (ED), his systolic blood pressure (SBP) drops to the 30s and is fluid unresponsive. What is the most appropriate next step in management?

- A. Computed tomography (CT) scan of the neck and chest
- B. Dopamine infusion at 20  $\mu\text{g/kg/min}$
- C. Emergent blood transfusion
- D. Emergent surgical consultation for neck exploration
- E. Resuscitative thoracotomy

**Answer: E.** After penetrating trauma, the presence of profound shock or cardiopulmonary arrest unresponsive to fluids should prompt the initiation of a resuscitative ED thoracotomy. During that procedure, options C and D should already be in place, but this patient is too unstable to be transported to CT scan and while in extremis, should remain in the ED for the thoracotomy. Another consideration if the thoracotomy does not yield hemodynamic improvement is that of a venous air embolus.

## KEY CONCEPTS

- Even relatively minor chest wall injuries, such as rib fractures, may result in serious complications in elderly patients and patients with preexisting pulmonary disease if adequate analgesia and close follow-up care are not provided.
- Unless there are abnormalities on the electrocardiogram (ECG) or an elevated serum troponin level, there is no need to pursue the diagnosis of myocardial contusion with more sophisticated tests.
- Many patients with myocardial rupture or traumatic aortic rupture survive to reach the hospital and can be salvaged with rapid diagnosis and intervention.
- Pericardial tamponade can be diagnosed accurately before hemodynamic decompensation occurs by standard cardiac ultrasound performed by emergency clinicians.
- Chest computed tomography (CT) scan is the test of choice for blunt aortic injury even in the presence of normal chest radiographs.
- The NEXUS-Chest CT criteria can be used to determine the need for chest CT in patients with blunt trauma.

## CHAPTER 38: QUESTIONS &amp; ANSWERS

- 38.1.** An 18-year-old man presents after a motor vehicle collision (MVC) in which he was ejected from the vehicle. The paramedics have been administering bag-valve-mask ventilation en route because of respiratory distress and now report increased resistance with ventilations. The patient has decreased breath sounds on the left. His blood pressure is 80/40 mm Hg, and his pulse is 145 beats per minute. His respirations are agonal, with a rate of 5 breaths per minute. Which of the following is the most appropriate next step in the management of this patient?
- Anteroposterior chest radiograph
  - Emergency department thoracotomy (EDT)
  - Endotracheal intubation
  - Needle decompression
  - Tube thoracostomy

**Answer: D.** This clinical scenario depicts a patient with a tension pneumothorax. He has decreased blood pressure, decreased breath sounds, and, most important, an increased resistance to ventilation, which is the earliest sign of the development of a tension pneumothorax. Immediate decompression with a large-bore needle is the correct initial management in this condition.

- 38.2.** Which of the following is the most sensitive electrocardiogram (ECG) manifestation of myocardial contusion?
- Biphasic T wave
  - Left bundle branch block
  - Right bundle branch block
  - Sinus tachycardia
  - Transient ST segment elevation

**Answer: D.** Sinus tachycardia is present in approximately 70% of patients with documented myocardial contusion and is the most sensitive sign for this condition. It is, however, also the least specific.

- 38.3.** A patient presenting with blunt thoracic trauma complains of shortness of breath and chest pain. On physical examination, he is tachypneic with chest wall bruising and moist rales on the right side on auscultation. Which of the following is the least likely finding?
- Consolidation within 6 hours of injury
  - Diffuse patchy alveolar infiltrates on chest radiograph in 24 hours
  - Low partial arterial pressure of oxygen ( $\text{PaO}_2$ ) on arterial blood gas sampling
  - Patchy alveolar infiltrate on chest radiograph within minutes of injury
  - Rib fractures

**Answer: B.** This patient has physical findings consistent with pulmonary contusion. All answers are correct except B. Delayed onset of diffuse alveolar infiltrates is more consistent with acute respiratory disease syndrome (ARDS). The development of ARDS is diffuse and usually delayed, with onset typically between 24 and 72 hours after injury.

- 38.4.** A 55-year-old man complains of chest wall pain after a high-speed motor vehicle collision (MVC). He has ecchymosis of the left lateral chest wall. You notice that there is outward movement of the left lateral chest wall on expiration. Which of the following statements regarding this patient's problem is *not true*?
- Chest radiograph likely demonstrates parenchymal contusions.
  - Intubation splints the chest wall internally.
  - Multiple rib fractures are likely.
  - Positioning of patient with injured side down improves symptoms.
  - The cornerstone of treatment is pulmonary physiotherapy.

**Answer: D.** This patient has a flail chest. Out-of-hospital or emergency department (ED) stabilization of the flail segment, by positioning the person with the injured side down or placing a sandbag on the affected segments, has been abandoned. Endotracheal intubation and positive-pressure ventilation will internally splint the chest wall, making the flail segment difficult to detect on physical examination. The cornerstones of therapy include pulmonary physiotherapy, effective analgesia, selective use of endotracheal intubation and mechanical ventilation, and close observation for respiratory compromise.

- 38.5.** A 50-year-old woman is brought in by emergency medical services on a backboard after a motor vehicle collision (MVC), complaining of shortness of breath. She has decreased breath sounds on the right side of the chest. A chest tube is placed, with a return of 200 mL of blood in the first hour, 200 mL in the second hour, and 350 mL in the third hour. What is the next step in the management of this patient?
- Check coagulation profile
  - Conservative management and transfusion as needed
  - Emergency thoracotomy
  - External fixation of rib fractures
  - Insertion of a second thoracostomy tube

**Answer: C.** Immediate drainage of more than 1500 mL of blood from the pleural cavity is usually considered an indication for urgent thoracotomy. Perhaps even more predictive of the need for thoracotomy is a continued output of at least 200 mL/hr for 3 hours.

**38.6.** A 37-year-old man presents with chest pain after a motor vehicle collision (MVC). He states that his chest hit the steering wheel. On initial evaluation, the patient is without fractures of the ribs or sternum, but there is a small chest wall contusion. The initial chest radiograph is negative, and the electrocardiogram (ECG) shows nonspecific ST-T wave changes. What is the next step in the emergency management of this patient?

- A. Admit to telemetry for 23-hour observation
- B. Discharge home after repeat ECG and troponin at 6 hours
- C. Discharge home after repeat ECG in 1 hour
- D. Discharge home if echocardiogram is negative
- E. Discharge home if initial troponin is negative

**Answer: B.** In patients who have minor injuries and are otherwise asymptomatic, elevated troponin levels and minor ECG abnormalities do not necessarily indicate a clinically significant myocardial contusion. Very few of these patients will develop complications. However, normal troponin level (4 to 6 hours after injury), along with normal (or unchanged) ECGs, correlate with minimal risk of cardiac complications. Echocardiography is rarely required in this low-risk subset of patients who have minor injuries and are otherwise asymptomatic.

**38.7.** A 30-year-old woman presents intubated by emergency medical services on a backboard with C spine immobilization. She was found unresponsive and hypotensive after a front-end collision. She was the driver of the vehicle and unbelted. Despite fluid resuscitation, the patient continues to be tachycardic and hypotensive. On physical examination, you note jugular venous distention (JVD) and a harsh murmur that sounds like a splashing mill wheel. An electrocardiogram (ECG) reveals electrical alternans. Which of the following statements is true regarding the patient's underlying problem?

- A. Echocardiogram will reveal diastolic collapse of the right ventricle and fluid in the pericardium.
- B. Focused assessment with sonography in trauma (FAST) will demonstrate echogenicity in Morrison's pouch.
- C. Patchy consolidation will be seen on chest radiograph.
- D. Pericardiocentesis is not indicated.
- E. She will have a negative focused abdominal sonogram.

**Answer: A.** Early use of emergency department (ED) ultrasonography may facilitate the early diagnosis of cardiac rupture and pericardial tamponade. The combination of shock and JVD (or an elevated central venous pressure [CVP]) in a patient with blunt chest trauma should immediately suggest pericardial tamponade.

## KEY CONCEPTS

- The accuracy of physical examination is limited in cases of abdominal trauma. It is rendered less reliable by distracting injury, altered sensorium (eg, head trauma, alcohol or drug intoxication, developmental delay, psychiatric illness), and spinal cord injury.
- Stab and gunshot wounds frequently violate the lung parenchyma, diaphragm, mediastinum, intraperitoneal cavity, and retroperitoneum in some combination.
- Physical examination with E-FAST, followed by CT scan when indicated, provides accurate diagnosis for the majority of blunt and penetrating abdominal trauma patients.
- Emergent laparotomy is indicated for patients sustaining a stab wound in the setting of hemodynamic compromise, peritoneal signs, evisceration, or left-sided diaphragmatic injury. Patients not meeting these criteria undergo a combination of LWE, CT scan, serial examination and E-FAST, depending on the location of the wound
- Emergent laparotomy is indicated for patients sustaining a gunshot wound in the setting of hemodynamic compromise, peritoneal signs, or peritoneal violation. Patients not meeting these criteria undergo a combination of LWE, CT scan, serial examination and E-FAST, depending on the location of the wound.
- The critical determinant in hemodynamically unstable patients with pelvic fracture is the existence of active intraperitoneal hemorrhage. Discovery of this by E-FAST, CT scan, or peritoneal aspiration is an indication for laparotomy, whereas its absence prompts diagnostic and potentially therapeutic angiography.

## CHAPTER 39: QUESTIONS &amp; ANSWERS

- 39.1.** The focused assessment with sonography in trauma (FAST) scan of a patient with blunt abdominal trauma shows a hypoechoic stripe in the pouch of Douglas. Which of the following is correct?
- In the presence of hemodynamic instability, this indicates a need for laparotomy.
  - The patient needs to go for emergent laparotomy.
  - The patient requires repeat abdominal examinations and FAST examinations in the emergency department (ED).
  - There is at least 50 mL free fluid in the abdomen.
  - This indicates a ruptured bladder.

**Answer: A.** The pouch of Douglas is one of the areas of ultra sound inspection for a FAST examination. If free fluid is present and the patient is hemodynamically unstable, the patient should forego computed tomography (CT) scanning for the operating room. FAST examinations are effective in detecting as little as 100 mL of free fluid in the abdominal cavity.

- 39.2.** An 18-year-old man presents after a moderate-velocity front-end vehicle collision. He has a blood pressure of 110/70 mm Hg, heart rate of 120 beats per minute, respiratory rate of 17 breaths per minute, and a Glasgow Coma Score (GCS) of 13. On physical examination, he has a tender abdomen and an unstable pelvis. A FAST examination is positive for free fluid in the abdomen. What should be the next step in this patient's management?
- Admission to the trauma service for observation
  - Diagnostic peritoneal lavage (DPL) followed by laparotomy if 5 mL blood is aspirated
  - DPL followed by laparotomy if 10 mL of grossly bloody aspirate is obtained
  - Emergency laparotomy
  - ED observation for 12 hours with repeat FAST examinations

**Answer: C.** Although the sensitivity of FAST examinations for identifying intra-abdominal injuries requiring surgical intervention is not high, it still serves as a tool to triage patients to the next intervention. In an unstable patient, a positive FAST ultrasound scan is followed by a supraumbilical peritoneal aspirate. If this reveals 10 mL or more of blood, then the patient should expeditiously move to laparotomy.

- 39.3.** Which of the following is *not* an advantage of CT scanning over diagnostic peritoneal lavage (DPL) in assessing patients with blunt abdominal trauma?
- Identification of hemorrhage
  - Evaluation of genitourinary injury
  - Evaluation of retroperitoneum
  - Evaluation of unstable trauma patients
  - Quantification of hemorrhage

**Answer: D.** In most situations, CT scanning has supplanted DPL because of its higher predictive ability for operative lesions and the fact that it is noninvasive. CT scanning can define the injured organ and the extent of the injury. It is most accurate for solid visceral lesions and accurately discerns the presence, source, and approximate quantity of intraperitoneal hemorrhage. It can demonstrate active bleeding from the liver or spleen, and it can be used to determine whether therapeutic angiographic embolization is indicated. CT scanning also evaluates the retroperitoneum. In cases of blunt trauma, DPL's primary remaining use is the triage of the patient who is hemodynamically unstable and has multiple injuries with an equivocal FAST examination.

- 39.4.** Which of the following statements regarding radiation exposure from CT scans in the setting of blunt abdominal trauma is false?
- A single CT scan may increase the lifetime risk of cancer.
  - CT scans are never indicated in pregnancy, given the risk of radiation to the fetus.
  - Institutions should follow as low as reasonably achievable (ALARA) principles to mitigate radiation exposure.
  - Medical radiation may be responsible for 0.4 to 1% of all cancers in the United States.
  - Patients transferred to another facility should have attempts made to convey the images to the receiving facility as long as it does not negatively impact the patient's care.

**Answer: B.** Although there is a risk to the fetus with radiation, there may be situations where the risk of missed injury or exploratory laparotomy outweighs the risk of radiation to both mother and fetus. Patients being transferred to another facility should have attempts made to provide CT scans either in hard copy or digitally, to minimize repeat radiation exposure to the patient. Current estimates suggest at least 0.4% of all cancers in the United States are secondary to medical radiation, and a single CT scan may increase the lifetime risk of cancer. Facilities can minimize this risk by adopting ALARA principles.

39.5. A 27-year-old male presents 4 hours after an isolated stab wound to the anterior abdomen. His vital signs are heart rate 84 beats per minute and blood pressure 115/64, and the lactate level is 0.9 mg/dL. His focused assessment with sonography in trauma (FAST) examination is negative for free fluid. He denies alcohol and drug use and appears clinically sober. Which of the following statements regarding this patient's subsequent management is true?

- A. A diagnostic peritoneal lavage (DPL) with 250,000 red blood cells per mm<sup>3</sup> indicates the need for admission and serial abdominal examinations.
- B. A local wound exploration (LWE) that fails to demonstrate peritoneal violation means that the patient can be discharged from the emergency department (ED).
- C. A negative computed tomography (CT) scan rules out the need for further evaluation.
- D. The negative FAST examination rules out intra-abdominal injury requiring operative intervention.
- E. The patient meets criteria for emergent laparotomy.

**Answer: B.** Simple anterior abdominal stab wounds that do not violate the peritoneum can be discharged from the ED after appropriate wound care (see Fig. 39-6). Not all anterior stab wounds meet indication for laparotomy, even in the presence of peritoneal penetration. A DPL of greater than 100,000 red blood cells (RBCs)/mm<sup>3</sup> is an indication for laparotomy in abdominal stab wounds. A negative FAST examination does not rule out significant intra-abdominal injury or even small-volume hemo-peritoneum in either penetrating or blunt abdominal trauma. CT scans poorly visualize both the small bowel and diaphragm and cannot be used in isolation to rule out injury in penetrating abdominal trauma.

39.6. A 67-year-old female who is taking warfarin (Coumadin) for atrial fibrillation presents after a high-mechanism motor vehicle collision. Her heart rate is 142 beats per minute and blood pressure is 84/40 after 1 L of normal saline. Her Glasgow Coma Score (GCS) is 6, and her left pupil is 6 mm versus 3 mm on the right. Her physical examination is notable for a seat belt sign on the abdomen. Which of the following is *not* an acceptable approach to her initial assessment and treatment?

- A. Perform a focused assessment with sonography in trauma (FAST) examination to evaluate for the presence of intra-abdominal fluid.
- B. Perform chest and pelvic radiographs in the resuscitation bay.
- C. Perform empirical craniotomy concurrently with laparotomy in the operating room after a positive diagnostic peritoneal aspiration.
- D. Perform endotracheal intubation and begin mild hyperventilation.
- E. Proceed to radiology for an emergent abdominal CT scan.

**Answer: E.** The patient is hemodynamically unstable, with suspected intra-abdominal injuries in conjunction with signs of herniation. CT scanning of the abdomen would be inappropriate in this patient. Several concurrent management options to stabilize the patient and determine the source of her hypotension are desirable (see Fig. 39.10). Endotracheal intubation allows airway control and possible hyperventilation to delay impending herniation. Chest and pelvic radiographs rule out other sources of ongoing hemorrhage and may support emergent laparotomy. A FAST examination can confirm the presence of intra-abdominal free fluid, which in the setting of hemodynamic instability is an indication for laparotomy. Finally, after confirmation of intra-abdominal blood by either digital pulse analyzer (DPA) or FAST, proceeding to the operating room, with or without emergent CT scanning of the head, are management options. If the head CT is foregone because of instability, empirical craniotomy is an acceptable management option.

39.7. Which of the following statements regarding splenic injuries in blunt abdominal trauma is false?

- A. A CT scan with a grade IV splenic laceration indicates the need for laparotomy.
- B. Angiographic embolization may preserve some of the immune function of the spleen, even in the setting of a grade V laceration.
- C. Bedside focused assessment with sonography in trauma (FAST), although sensitive for intra-abdominal fluid, is a relatively poor test for the evaluation of solid organ injury.
- D. CT scanning followed by serial abdominal examinations and hematocrits is a reasonable management option at experienced centers.
- E. Mononucleosis increases the risk of splenic laceration from seemingly minor blunt abdominal trauma.

**Answer: A.** High-grade splenic lacerations, although having a higher rate of failed nonoperative or angiographic embolization management, do not represent a definitive indication for laparotomy. Mononucleosis does increase the risk of splenic laceration. Trauma can be so minor that the patient may have little recollection of the remote trauma responsible. Serial abdominal examinations, laboratory tests, and/or repeat FAST examinations are reasonable management options at experienced centers. Limited studies have suggested that angiographic embolization does preserve some of the immune function of the spleen compared with splenectomy. The FAST examination does not visualize solid organ injury effectively enough to eliminate the need for further evaluation with CT scanning in this case, especially because laparotomy is not necessarily indicated.



## KEY CONCEPTS

- Microscopic or gross hematuria is suggestive of genitourinary trauma; however, the degree of hematuria does not correlate well with the severity of injury.
- The kidney is the most frequently injured genitourinary organ, and imaging should be considered in patients with gross hematuria or microscopic hematuria with hemodynamic instability.
- Delayed CT images after IV contrast should be obtained in patients with mechanism or findings suggestive of ureteral trauma. Blunt ureteral trauma is rare.
- CT scan with IV contrast is not sensitive for diagnosing bladder injury, and retrograde cystography should be obtained if there is any concern to allow proper distention of the bladder to allow for urinary extravasation.
- Pelvic fractures associated with hematuria strongly suggest urethral injury.
- Retrograde urethrography (RUG) should be performed in patients with pelvic fractures and hematuria, perineal ecchymosis or swelling, or those with blood at the urethral meatus, because passage of a Foley catheter blindly in these settings can worsen a preexisting urethral injury.
- Genital injury is rarely life threatening, but prompt diagnosis and evaluation is necessary to decrease the likelihood of future morbidity in these patients.

## CHAPTER 40: QUESTIONS &amp; ANSWERS

**40.1.** All of the following are associated with clinically significant blunt renal injuries in adult patients and would warrant further evaluation, except:

- A. A sudden decelerating mechanism of injury in a patient without microhematuria
- B. A sudden decelerating mechanism of injury in a patient without shock
- C. Gross hematuria
- D. Microscopic hematuria
- E. Microscopic hematuria in a patient with shock

**Answer: D.** Renal injury requiring intervention is rare in the absence of gross hematuria or shock. Gross hematuria warrants careful evaluation for significant genitourinary injury, although the degree of hematuria does not necessarily correlate with the degree or grade of injury and significant genitourinary trauma can occur without hematuria. Microscopic hematuria in a blunt trauma patient without shock is not an indication for renal imaging, even if there is evidence of local trauma (eg, costovertebral angle tenderness or localized ecchymosis). Although renal injury may uncommonly be identified on imaging for these patients, the injuries are mild and do not require intervention. Hemodynamic instability with evidence of intraperitoneal injury on abdominal examination, presence of pelvic fracture, a penetrating trauma mechanism, or presence of lower rib fractures, with or without hematuria, are indications for further investigation. Additionally, imaging is advisable for patients with gross hematuria, targeted to the entire urinary tract or localized to the lower tract (bladder and urethra), depending on the mechanism and location of the trauma.

**40.2.** A 27-year-old male presents after a motor vehicle collision complaining of abdominal pain. He was the restrained driver of a car struck on the driver's side by a delivery truck. His vital signs are blood pressure 118/72, heart rate 70 beats per minute, and respiratory rate 16 breaths per minute. Physical examination reveals left upper quadrant abdominal tenderness without guarding or rebound tenderness. There is no blood at the urethral meatus or scrotal hematoma. A Foley catheter is placed without difficulty and drains gross blood. A radiograph of the pelvis reveals fractures of the left superior and inferior pubic rami, and a focused assessment with sonography in trauma (FAST) examination reveals free fluid in the splenorenal pouch. Which of the following diagnostic strategies is most appropriate?

- A. Intravenous (IV) contrast-enhanced computed tomography (CT) of the abdomen and pelvis with delayed images of the bladder after clamping the Foley catheter to allow the IV contrast to collect in the bladder
- B. IV contrast-enhanced CT of the abdomen and pelvis with delayed images of the renal collecting system
- C. IV contrast-enhanced CT of the abdomen and pelvis and retrograde CT cystogram
- D. IV contrast-enhanced CT of the abdomen and pelvis and retrograde urethrogram
- E. Retrograde cystogram followed by IV pyelogram

**Answer: C.** This patient has clinical features concerning for several possible injuries, including a splenic laceration, renal injury, and bladder rupture. Significant urethral injury is less likely, given the examination findings and ease of Foley catheter placement. Because the patient is stable without apparent indication for laparotomy, the most appropriate diagnostic evaluation would be IV contrast-enhanced CT of the abdomen and pelvis and retrograde CT cystogram. The former will evaluate for solid organ injury and the latter for bladder rupture. It is essential that cystography not be done in an antegrade fashion, because such studies (eg, injecting IV contrast material, clamping the Foley catheter, and allowing the examination to depend on antegrade filling of the bladder from renal excretion of progressively dilute contrast material) may produce incomplete and spurious findings because of inadequate distention of the bladder.

- 40.3.** A 72-year-old male presents with flank and pelvis pain after he slipped and fell on an icy sidewalk. His examination reveals normal vital signs and abrasions over the left flank and left iliac crest and is otherwise unremarkable. He has grossly clear urine, but a urinalysis reveals 25 red blood cells per high-power field. Radiographs of the pelvis and hips reveal no fracture, and the patient is able to ambulate without difficulty. What is the most appropriate next step?
- A. Obtain a renal ultrasound scan.
  - B. Obtain an IV contrast-enhanced CT of the abdomen and pelvis.
  - C. Perform a retrograde cystogram.
  - D. Perform a retrograde urethrogram.
  - E. Treat the patient's pain and discharge him home with outpatient urology follow-up in 1 week.

**Answer: E.** A significant genitourinary injury is unlikely, given the patient's history, physical examination, and urine findings. However, outpatient urology follow-up until microhematuria has cleared is advisable to be certain that it does not represent another more serious underlying (nontraumatic) condition.

- 40.4.** A 35-year-old female presents after being stabbed with an ice pick during a robbery. Her examination is normal except for a 0.5-cm, hemostatic wound to the right flank at the level of the second lumbar vertebrae. Bedside ultrasonography reveals no free intra-abdominal fluid. Her urinalysis does not contain blood. What is the most appropriate next step?
- A. Obtain a renal ultrasound scan.
  - B. Obtain an IV contrast-enhanced CT of the abdomen and pelvis, with additional images of the renal collecting system 10 minutes after contrast injection.
  - C. Perform a retrograde cystogram.
  - D. Perform a retrograde urethrogram.
  - E. Treat the patient's pain, counsel her on appropriate wound care, and discharge her home with outpatient urology follow-up in 1 week.

**Answer: B.** In cases of penetrating renal trauma, the presence or absence of hematuria is not a reliable predictor of upper urinary tract injury. The location of the penetrating injury in relation to the urinary tract is the most important determining factor in deciding the need for radiographic investigation. Therefore, the absence of hematuria in a patient with a gunshot or stab wound in proximity to the urinary tract does not eliminate the need for IV contrast-enhanced CT as the initial diagnostic examination. Significant injuries to the kidney and ureter may occur in penetrating trauma without hematuria. Additional images obtained at 10 minutes after contrast injection are indicated to evaluate for delayed contrast extravasation and to maximize the sensitivity of the study.

- 40.5.** A 25-year-old male presents after an unfortunate incident resulting in a scrotal injury and a left testicle that was traumatically amputated (the patient brings the amputated testicle with him in a towel). All of the following would be indicated, except:
- A. Analgesics for the patient
  - B. Emergent urological consultation
  - C. Place the amputated testicle directly on ice
  - D. Prepare the patient for possible operative exploration by the surgeon
  - E. Wrap the amputated testicle in saline soaked gauze

**Answer: C.** Amputations of either the testicles or penis require immediate surgical evaluation. In the interim, the amputated part should be wrapped in saline-soaked gauze, and then placed in a sealed bag, which can then be placed in another bag that is filled with ice. The amputated part should never be placed directly on ice. Direct pressure is usually adequate to achieve hemostasis.

- 40.6.** A 30-year-old female presents after blunt abdominal trauma after a motor vehicle collision, and an ultrasound demonstrates free fluid. You suspect a bladder rupture. A true statement about this entity includes which of the following:
- A. A bladder contusion may be successfully managed with Foley catheterization drainage.
  - B. Extraperitoneal bladder injuries are typically managed with surgical intervention.
  - C. It is unimportant to distinguish an intraperitoneal from an extraperitoneal bladder rupture (EBR).
  - D. Most patients with an intraperitoneal bladder rupture (IBR) will resolve with Foley catheter drainage.
  - E. Most penetrating bladder injuries will resolve with Foley catheter drainage.

**Answer: A.** The distinction between EBR and IBR is important, because the management differs. Contusions and extraperitoneal injuries due to blunt trauma are typically managed conservatively with Foley catheterization, unless they are complicated by other intra-abdominal injuries, bladder neck injuries, bone fragments in the bladder wall, or if open reduction is performed on an associated pelvic fracture. In contrast, given the extremely low likelihood of IBR and penetrating injuries healing with conservative therapy, almost all patients with these types of injuries are taken to the operating room for exploration and repair. Without surgery, there is an extremely high likelihood of complications, which include infections and fistula formation.

## KEY CONCEPTS

- The overall condition of the patient determines the extent of emergency department (ED) evaluation and stabilization. Critically injured patients may require immediate surgery, which should not be delayed for confirmatory studies of obvious vascular injury.
- Arterial injury may be readily apparent or clinically occult. In patients with high-energy blunt mechanisms, computed tomography angiography (CTA) should be the initial diagnostic modality of choice. In patients with lower-energy mechanisms, serial physical examinations may be performed instead.
- Symptoms of arterial injury may be delayed by hours to months after the initial injury. Late onset of symptoms suggests delayed thrombosis, pseudoaneurysm or arteriovenous fistulae (AVF) formation, compartment syndrome, or intermittent claudication, resulting from stenosis or reliance on small-caliber collateral vessels for arterial perfusion.
- Compartment syndrome frequently develops in limbs with arterial injury, particularly injuries of the lower leg, and fasciotomy is often required.
- Many vascular injuries are amenable to endovascular treatment with self-expanding stents. This results in fewer complications, lower cost, and earlier discharge from the hospital.

## CHAPTER 41: QUESTIONS &amp; ANSWERS

- 41.1. An 18-year-old man presents complaining of left lower leg pain. He was involved in a motor vehicle collision (MVC) 1 month earlier and requires surgical repair of a left femur fracture. Which of the following is the *least* likely cause of the patient's symptoms?
- Compartment syndrome
  - Intimal flap
  - Pseudoaneurysm
  - Thrombosis
  - Vessel stricture formation

**Answer: A.** Delayed thrombosis can occur months to years after injury if the injured vessel heals with stricture formation and decreased blood flow distally, followed by stasis and clot formation. Although flow is not altered by small intimal flaps, and the associated soft tissue wounds often appear benign initially, they may become a nidus for thrombosis that can occur hours to months after the initial injury. The cavity of a pseudoaneurysm is in direct communication with the lumen of the vessel, so embolization of mural clots may produce distal arterial occlusion. Patients with pseudoaneurysm are commonly seen months to years later with symptoms of compression neuropathy or peripheral arterial embolism. The delayed presentation of this patient makes compartment syndrome the least likely cause of his leg pain.

- 41.2. A 45-year-old man complains of right leg pain and edema shortly after surgery for a mid-shaft femur fracture. Physical examination reveals decreased distal pulses in the extremity. What is the most important diagnosis to consider in this patient?
- Anemia causing poor tissue oxygenation
  - Compartment syndrome
  - Intimal flap
  - Pseudoaneurysm
  - Vessel stricture

**Answer: B.** After restoration of arterial flow to a previously ischemic limb, a cascade of reperfusion injury has been identified that results from release of oxygen free radicals, lipid peroxidation, and influx of intracellular calcium. These mediators give rise to progressive cellular damage, edema, and necrosis, thereby propagating the vicious cycle that increases compartment pressure.

- 41.3. After vascular injury to an extremity, how many hours are generally required before irreversible damage occurs?
- 2 hours
  - 6 hours
  - 10 hours
  - 12 hours
  - 24 hours

**Answer: B.** Although individuals may vary, 6 hours of complete warm ischemia is generally considered the point at which irreversible nerve and muscle damage begins to occur. After 6 hours of warm ischemia, 10% of patients will have irreversible damage; by 12 hours, 90% will have irreversible damage. Artificially cooling the limb to just higher than freezing temperature will reduce the metabolic demands of ischemic tissues and greatly prolong the tissue's tolerance of ischemia to 24 hours or more.

- 41.4. A 25-year-old man who sustained a gunshot wound to the right leg has an ankle-brachial index (ABI) of 0.9. What is the most appropriate next step in this patient's management?
- Admit for observation and repeat examinations.
  - Discharge the patient home with surgical follow-up.
  - Obtain an emergent computed tomography (CT) angiogram.
  - Obtain immediate vascular consultation.
  - Perform a Doppler ultrasound scan.

**Answer: A.** Patients with an ABI of 0.90 to 0.99 merit observation for 12 to 24 hours for repeat examinations and ABI measurements to detect evolving injury. In general, a ratio of less than 0.90 is considered abnormal and is an indication for further investigation, such as computed tomography angiography (CTA).

- 41.5. Which of the following is *least* likely to cause vascular injury to an extremity?
- Close-range shotgun wound
  - Crush injury
  - Electrical injury
  - Gunshot wound from a long distance
  - Massive tissue avulsion

**Answer: D.** Close-range shotgun wounds can cause significant blunt trauma to vessels, as well as a higher rate of bone and nerve damage than gunshot wounds. An open avulsion injury to limb is particularly severe because the skin is the final structure to be disrupted, and there is inevitable injury to deeper vessels and nerves. Vascular injury must be suspected in patients with massive soft tissue avulsion or crush injury, displaced long bone fractures, and electrical or lightning injuries.

## KEY CONCEPTS

- Consultation with an orthopedist should be sought for the treatment of most long bone fractures, open fractures, injuries with joint violation, and injuries with neurovascular compromise.
- A careful history and physical examination can predict radiographic findings with a high degree of accuracy. A presumptive diagnosis before a radiographic study may prompt the emergency clinician to order special views necessary to diagnose an injury correctly.
- Open fracture management should focus on the early administration of antibiotics, tetanus prophylaxis, coverage of the wound, and splinting of the extremity. Suggested therapy for open fractures includes a first-generation cephalosporin, such as cefazolin, with the addition of an aminoglycoside for type II or III open fractures.
- Compartment syndrome is associated most commonly with a closed long bone fracture of the tibia but also is well described in the thigh, forearm, arm, hand, and foot and can occur with soft tissue trauma alone. Clinical examination remains the diagnostic cornerstone of acute compartment syndrome, which can then be confirmed by compartment pressure measurement.
- Because of their blood supply, certain bones may undergo avascular necrosis after fracture, especially if fractures are comminuted and go untreated for any length of time. The femoral head, talus, scaphoid, and capitate are particularly prone to this complication.
- Fat embolism syndrome is a serious consequence of fat embolism, occurring most commonly after long bone fractures in young adults (usually tibia and fibula) and after hip fractures in older patients. ARDS is the earliest, most common, and serious manifestation. Neurologic involvement, manifesting as restlessness, confusion, or deteriorating mental status, is also an early sign, as are thrombocytopenia and a petechial rash.

## CHAPTER 42: QUESTIONS &amp; ANSWERS

- 42.1. A 6-year-old girl presents complaining of pain in her right ankle after tripping and falling in the playground. On physical examination, you note that there is moderate swelling and diffuse tenderness of the lateral ankle joint, with good pulses and normal sensation. Radiographs of the ankle do not demonstrate an acute fracture or disruption of the growth plates. What is the next step in this patient's management?
- Ace wrap, ice, pain medication, and orthopedic referral
  - Emergent orthopedic consult and preparation for the operating room
  - Orthopedic referral, ice, and pain medication
  - Splint, pain medication, and orthopedic referral
  - Urgent orthopedic consult, ice, and pain medication

**Answer: D.** A child with swelling and tenderness over an epiphysis (eg, of the lateral ankle) and a negative radiograph should be suspected to have an epiphyseal injury, rather than a sprain, because the epiphysis is weaker than the overlying ligaments.

- 42.2. Which of the following situations requires an emergent fasciotomy in the setting of a clinically suspected compartment syndrome?
- Elevated tissue pressure within a closed compartment
  - Pain on passive stretching of the muscle group involved
  - Tissue pressure less than the diastolic pressure
  - Tissue pressure of 20 mm Hg
  - Tissue pressure within 30 mm Hg of the mean arterial pressure

**Answer: A.** Controversy exists regarding attempts to define compartment syndromes on the basis of specific tissue pressure. The tolerance to tissue ischemia varies among individuals because of shock, compensatory hypertension, altered tone in resistance vessels, and other unknown factors. Inadequate perfusion and relative ischemia begin when the tissue pressure within a closed compartment increases to within 20 mm Hg of a patient's diastolic pressure or, more accurately, within 30 mm Hg of the mean arterial pressure. When tissue pressure equals or exceeds the patient's diastolic pressure, tissue perfusion effectively ceases.

- 42.3. Which of the following is not a manifestation of fat embolism syndrome?
- Altered mental status
  - Hematochezia
  - Petechial rash
  - Respiratory distress
  - Thrombocytopenia

**Answer: B.** Respiratory distress and hypoxemia are the earliest, most common manifestations of fat embolism syndrome. Acute respiratory distress syndrome (ARDS) may occur and is the usual cause of death. Neurologic involvement, manifesting as restlessness, confusion, or deteriorating mental status, also is an early sign, as are thrombocytopenia and a petechial rash. Fever, tachycardia, jaundice, retinal changes, and renal involvement may occur.



## KEY CONCEPTS

- Traumatic, infectious, and inflammatory conditions involving the hand are among the most commonly encountered problems in the ED.
- Obtaining a thorough history and performing a meticulous physical examination of the hand are paramount to the evaluation and development of an appropriate management strategy. Diagnostic imagery should be obtained with clinical suspicion.
- Timely and accurate evaluation and management yield the best functional outcomes with traumatic and infectious conditions of hand.
- Management of the acute hand condition should focus on maximizing function and minimizing long-term disability.
- Recognition of the need for hand specialist consultation or referral is extremely important for obtaining the best functional outcome for the patient.

## CHAPTER 43: QUESTIONS &amp; ANSWERS

- 43.1.** A 25-year-old man presents with a painful laceration of the forearm following a bicycle accident. The laceration transects the supinator muscle. The patient's physical examination shows his fingers held in flexion at the metacarpophalangeal (MCP) joint and thumb held in adduction. Which anatomic structure has been injured?

A. Median nerve  
 B. Musculocutaneous nerve  
 C. Radial artery  
 D. Radial nerve  
 E. Ulnar nerve

**Answer: D.** Motor function of the radial nerve is tested by having the patient extend the wrist against resistance. Proximal injury to the radial nerve causes a condition known as wristdrop, in which the fingers are held in flexion at the MCP joints, and the thumb is adducted.

- 43.2.** A young man presents after a fight complaining of a cut on his finger. On physical examination, you note a deformity to the distal second phalanx, with a laceration to the second MCP joint. What is the best management for this patient?
- A. Antibiotics, splint, and follow-up with hand surgery  
 B. Irrigation, topical antibiotic, and splint  
 C. Radiography, hand surgery consult, and antibiotics  
 D. Radiography, laceration repair, and splint  
 E. Radiography, urgent hand surgery follow-up, and cephalosporin

**Answer: C.** Lacerations or puncture wounds over the dorsum of the MCP joint associated with a metacarpal head fracture should be considered open until proved otherwise. Such injuries are often caused by a clenched fist injury and are highly contaminated wounds. Emergent consultation with a hand surgeon for operative débridement and irrigation is recommended. Prophylactic coverage with a cephalosporin is routinely recommended, although those with highly contaminated wounds also should receive penicillin with a  $\beta$ -lactamase inhibitor and an aminoglycoside.

- 43.3.** A 27-year-old woman was playing basketball and jammed her ring finger on the basketball. She presents with her ring finger held in flexion at the proximal interphalangeal (PIP) joint and hyperextension at the distal interphalangeal (DIP) and MCP joints. What is the next step in the management of this patient?
- A. Splint PIP in extension, allowing free movement of DIP and MCP.  
 B. Splint PIP in extension, MCP in flexion.  
 C. Splint PIP in extension, with full immobilization of digit.  
 D. Splint PIP in slight flexion allowing free movement of DIP and MCP.  
 E. Splint PIP in 90 degrees of flexion and extension of DIP and MCP.

**Answer: A.** This patient presents with a boutonnière deformity, which is a disruption of the central tendon, causing disruption in the extensor mechanism of the finger. Patients with suspected closed central tendon injuries should be treated with splinting of the PIP joint in full extension for 5 or 6 weeks. Only the PIP joint should be immobilized, and passive and active DIP joint flexion is encouraged from the outset. Operative repair may be required for an acute, closed boutonnière injury associated with a displaced avulsion fracture and injury with volar PIP joint dislocation. Early referral to a hand surgeon is advised.

- 43.4.** A mechanic presents with a complaint of right index finger fusiform swelling and pain following an injection injury with a grease gun. Which of the following approaches best describes the appropriate management?
- A. Digital block, elevation, and urgent surgical consult  
 B. Digital block, splint, and outpatient antibiotics  
 C. Digital block, splint, and urgent surgical consult  
 D. Parenteral pain medication, splint, and emergent surgical consult  
 E. Parenteral pain medication, splint, and outpatient surgical evaluation

**Answer: D.** Initial emergency department (ED) management includes splinting, elevation, tetanus prophylaxis, analgesia, and broad-spectrum antibiotics. Digital blocks are contraindicated because of the potential for increased tissue pressure, which may aggravate vascular compromise. Emergent hand surgery consultation is warranted because most cases require early extensive surgical decompression and débridement.

- 43.5.** Which of the following are diagnostic criteria for flexor tenosynovitis?
- A. Flexor contracture, flexor fluctuance, digit held in flexion, flexor erythema  
 B. Flexor tendon tenderness, pain on passive flexion, symmetric swelling, digit held in flexion  
 C. Flexor tendon tenderness, symmetric swelling, pain on passive extension, digit held in flexion  
 D. Pain, paresthesias, pulselessness, pallor  
 E. Pain out of proportion to physical examination

**Answer: C.** Four cardinal signs of acute flexor tenosynovitis (Kanavel's signs) are usually present and help differentiate tenosynovitis from other soft tissue infections in the hand: (1) tenderness along the course of the flexor tendon; (2) symmetric swelling of the finger; (3) pain on passive extension; and (4) a flexed posture of the finger. All four signs may not be present early in the course of infection.



- 43.6. How much angulation is acceptable in a metacarpal neck fracture?
- A. 20 degrees at index finger
  - B. 25 degrees at middle finger
  - C. 35 degrees at index finger
  - D. 45 degrees at little finger
  - E. 50 degrees at index finger

**Answer: D.** Generally, less than 15 degrees angulation is allowed in the index and long finger metacarpals; in the ring and little finger metacarpals, 35 and 45 degrees of angulation are allowed, respectively. Any rotational misalignment should be completely corrected.

- 43.7. A 30-year-old woman presents after getting her index finger caught in her car door. Examination of the finger reveals a dark red discoloration beneath the nail involving approximately 25% of the nail. The nail is intact and the nail margins are not disrupted. Radiographs are negative. What is the most appropriate management?
- A. Consult with hand surgery
  - B. Nail trephination
  - C. Oral pain medication, arrangements for follow-up
  - D. Performance of a digital block
  - E. Removal of the nail and repair of the nail bed laceration

**Answer: C.** Small subungual hematomas do not require drain age; the blood is incorporated into the nail and eventually removed with the free edge. Large (>50% of the nail) hematomas cause significant discomfort and should be removed by nail trephination.

- 43.8. A 42-year-old man presents with a painful swollen tip of his index finger. Four days earlier, he sustained a puncture wound to his fingertip. The physical examination is significant for tenderness, swelling, redness, and increased pressure in the distal pulp space of the affected finger. Which of the following is the best management strategy?
- A. Deep midline volar incision to the flexor tendon sheath
  - B. Finger splint, oral antibiotics
  - C. Fishmouth incision
  - D. Intravenous antibiotics, emergent hand surgery consult
  - E. Lateral incision along the ulnar aspect of the fingertip

**Answer: E.** Felons are traditionally managed with incision through the septa to drain and relieve pressure in septal compartments. Most felons can be drained by a single lateral incision. The incision should be made along the ulnar aspect of the index, middle, and ring fingers and the radial aspects of the thumb and little finger, avoiding pincher surfaces. Fishmouth incisions may destroy the blood supply to the fingertip. Any incision that is made too deeply and proximally can injure the flexor tendon sheath, initiating a tenosynovitis.

- 43.9. Which of the following statements regarding foreign bodies in the hand is true?
- A. A single radiograph is sufficient when looking for foreign bodies
  - B. Hand foreign bodies should always be removed emergently.
  - C. Magnetic resonance imaging (MRI) can improve the ability to detect foreign bodies.
  - D. Most glass foreign bodies are radiographically occult.
  - E. Wooden foreign bodies are readily visible on plain radiography.

**Answer: C.** Radiography is the best method for detecting radiopaque foreign bodies, including most glass. Radiographs should be taken using a soft tissue technique, with multiple views. Wooden foreign bodies are difficult to visualize radiographically. MRI, computed tomography (CT), and ultrasound can identify radiographically occult foreign bodies. Decisions regarding the necessity and timeliness of foreign body removal are based on the size and reactivity of the foreign body, proximity to vital structures, degree of wound contamination, and presence or absence of symptoms.

- 43.10. What is the proper ED management of a closed mallet finger injury?
- A. Splint the DIP and PIP joints in extension.
  - B. Splint the DIP and PIP joints in extension and MCP joint in flexion.
  - C. Splint the DIP joint in flexion.
  - D. Splint the DIP joint in slight hyperextension.
  - E. Splint the DIP and PIP joints in flexion.

**Answer: D.** The management of a closed mallet finger injury consists of maintaining continuous DIP extension for 6 to 8 weeks, allowing for tendon healing to occur. The DIP joint is immobilized in slight hyperextension, but the PIP and MCP joints are allowed to move freely. An excessive degree of hyperextension should be avoided because this can lead to skin necrosis on the dorsal surface of the DIP joint.

## KEY CONCEPTS

- On the PA radiograph of the wrist, three arcs, known as Gilula's lines, and equal spacing between carpus bones (1–2 mm), known as parallelism, assist in the radiographic diagnosis of carpal injury.
- In the setting of acute trauma, there is a high incidence of occult fractures and soft tissue injuries of the wrist. Because of the associated risk of malunion, nonunion, posttraumatic arthritis, and AVN if diagnosis is delayed, splint immobilization is recommended when radiographs are negative and pain persists. A thumb spica is usually added in the setting of suspected scaphoid and other carpal fractures. Follow-up for repeat physical examination, radiographs, or advanced imaging (eg, MRI, CT, or bone scan) is indicated.
- Routine wrist radiographs (AP, lateral, and oblique projections) fail to detect 15% of scaphoid fractures. Approximately one in four (25%) of splinted patients will subsequently be diagnosed with a scaphoid fracture.
- Triquetral dorsal chips are best seen on the standard lateral view of the wrist as a small avulsion fracture fragment, although a more oblique pronated lateral view may be necessary to visualize it.
- Hamate and pisiform fractures are better visualized with a carpal tunnel or reverse supinated oblique radiograph.
- Lunate dislocation results in a characteristic triangular appearance of the lunate on the PA view (so-called piece of pie sign) owing to rotation of the lunate in a volar direction. This rotation also is visible on the lateral view of the wrist, on which the lunate looks like a cup tipped forward and spilling its contents into the palm (spilled teacup sign).

## CHAPTER 44: QUESTIONS &amp; ANSWERS

44.1. In the setting of acute trauma and negative radiographs of the wrist, which clinical examination method(s) is (are) used to detect occult scaphoid fractures?

- A. All of these
- B. Anatomic snuffbox tenderness
- C. None of these
- D. Scaphoid tubercle tenderness
- E. Thumb metacarpal compression tenderness

**Answer: A.** In the setting of acute trauma and negative radiographs, tenderness to palpation within the anatomic snuffbox, on the scaphoid tubercle, or with thumb metacarpal compression are all suggestive of occult scaphoid fracture.

44.2. A 45-year-old man complains of wrist pain after falling on an outstretched hand. What injury is shown in this radiograph of the patient's wrist?



- A. Barton's fracture
- B. Lunate dislocation

- C. Perilunate dislocation
- D. Scaphoid fracture
- E. Scapholunate dissociation

**Answer: E.** The radiograph shows the signet ring, or cortical ring sign, which refers to the rotary subluxation of the scaphoid and oval appearance of the tubercle in the anteroposterior (AP) view of the wrist. On a properly positioned radiograph, this sign is typically associated with scapholunate widening, suggesting ligamentous laxity or dissociation. The signet ring sign is also used to describe pulmonary computed tomography (CT) imaging of bronchiectasis in relation to a dilated bronchus and associated pulmonary artery.

44.3. A 55-year-old man complains of wrist pain after a fall onto an outstretched arm. There is pain and swelling along the carpal bones. Also noted is decreased two-point sensation distally on the tips of the index and middle digits. Which structure is most likely injured?

- A. Median nerve
- B. Radial artery
- C. Radial nerve
- D. Ulnar artery
- E. Ulnar nerve

**Answer: A.** The median nerve courses through the carpal tunnel on the ventral aspect of the wrist. It provides sensation to most of the palm and thumb, half of the ring finger and, specifically, the tips of the index and middle digits. The median nerve is the most common neurapraxia associated with Colles' fractures.

44.4. Which nerve is commonly associated with Monteggia's fracture?

- A. Muscular branch of the radial nerve
- B. Posterior interosseous nerve
- C. Deep branch of the ulnar nerve
- D. Median nerve
- E. Ulnar nerve

**Answer B:** Injury to the posterior interosseous nerve (PIN), a deep branch of the radial nerve, is commonly associated with Monteggia's fracture. Because the PIN innervates the finger extensors along with the supinator, associated injury is often manifested by weakness or paralysis of the thumb and/or finger extension.

## KEY CONCEPTS

- Clinical decision rules for the elbow joint have not been validated. Radiographs should be obtained when there is limitation in range of motion, moderate to severe pain, obvious deformity, joint effusion, or significant tenderness or crepitus over any of the bony prominences or the radial head. The threshold for imaging should be lower in pediatric patients (with the exception of presentation consistent with radial head subluxation) owing to the presence of open growth plates and limitations to the physical examination.
- In children with wrist pain and traumatic mechanism of injury, the absence of a clear-cut explanation for the pain (eg, no abnormal radiographic findings) should prompt consideration of an elbow injury causing referred pain to the wrist.
- On lateral elbow x-ray, a small anterior fat pad, parallel to the anterior surface of the humerus, can be a normal finding. Any convex ("sail sign") anterior fat pad and all posterior fat pads are pathological and indicate presence of joint effusion. In the setting of trauma, almost all patients with the posterior fat pad sign of the elbow have intra-articular skeletal injury. In adults, a posterior fat pad sign is indicative of a radial head fracture, whereas in children, a supracondylar fracture is the probable underlying injury. In the absence of trauma, inflammation and infection also cause effusion with positive fat pad signs.
- Radial nerve injury is the most common complication of humeral fracture and occurs 20% of the time. This is most often a benign neurapraxia that resolves spontaneously, although recovery may take several months. Radial nerve injuries associated with penetrating trauma or open fractures are likely to represent anatomical disruption and usually warrant operative exploration.
- Generally the radius and ulna, bound together firmly by the annular ligament and interosseous membrane, displace as a unit and typically dislocate posteriorly.
- Biceps tendon rupture occurs almost exclusively in men, most commonly between ages 40 to 60, usually subsequent to an unexpected extension force applied to the arm flexed at 90 degrees. Smoking, diabetes, chronic renal failure, systemic lupus erythematosus, rheumatoid arthritis, and steroid or fluoroquinolone therapy may predispose to this injury.

## CHAPTER 45: QUESTIONS &amp; ANSWERS

**45.1.** A 23-year-old man presents with arm pain and weakness after a gunshot wound to the left upper arm. Physical examination is remarkable for a small penetrating wound at the midlateral aspect of the biceps muscle, extensor weakness of the thumb and wrist, and intact distal pulses. Which of the following statements is true?

- A. Angiography is indicated.
- B. Cervical radiography is warranted.
- C. Operative exploration is indicated.
- D. The neurapraxia should resolve.
- E. Urgent nerve conduction studies are indicated.

**Answer: C.** Radial nerve palsy resulting from penetrating injury or open fractures is often permanent and warrants operative exploration. Nerve conduction studies would not be abnormal until approximately 3 weeks post injury.

**45.2.** A 4-year-old boy is brought to the emergency department (ED) by his mother after falling from a swing set. He complains of right wrist pain and resists detailed examination of the arm. Radiographs are normal. What is the most appropriate next step in this patient's management?

- A. Computed tomography (CT) scan of the wrist
- B. Elbow radiograph
- C. Reassurance
- D. Splinting for 3 to 6 weeks
- E. Triple-phase bone scan after 7 to 10 days

**Answer: B.** In children with wrist pain and traumatic mechanism of injury, the absence of a clear-cut explanation for the pain (eg, normal radiograph) should prompt suspicion for an elbow injury producing referred pain.

## KEY CONCEPTS

- Axillary nerve function is best evaluated by testing the motor function of the deltoid muscle.
- The three-view trauma series of the shoulder (true anteroposterior, scapular Y, and axillary views) leads to an accurate radiographic diagnosis of most fractures and dislocations, although specialized views are sometimes necessary. Consider the presence of unfused epiphyses in adolescents and young adults.
- Most fractures can be treated with simple immobilization with good functional outcomes.
- The most important aspect of scapular fractures, scapulothoracic dissociation and posterior sternoclavicular joint (SCJ) dislocations is the high incidence of associated injuries to the ipsilateral lung, chest wall, mediastinum, or shoulder girdle complex.
- Most studies have concluded that conservative treatment is best for type III acromioclavicular joint (ACJ) dislocations.
- Recurrence is a common complication after anterior dislocation, especially in male patients younger than 30 years old, and such patients may benefit from surgical repair.
- Posterior dislocation should be included in the differential diagnosis of any shoulder injury, particularly in patients who reports shoulder pain after a convulsive episode.
- Ultrasound can be a useful technique for diagnosing tendon tears, selected soft tissue conditions, fractures, dislocation, as well as confirming reduction.
- Early initiation of passive shoulder range-of-motion exercises reduces the risk of adhesive capsulitis when the shoulder is immobilized for any reason.

## CHAPTER 46: QUESTIONS &amp; ANSWERS

**46.1.** Which of the following represents a true orthopedic emergency?

- A. Anterior glenohumeral dislocation
- B. Anterior sternoclavicular dislocation
- C. Biceps rupture
- D. Posterior glenohumeral dislocation
- E. Posterior sternoclavicular dislocation

**Answer: E.** Posterior sternoclavicular dislocations can be associated with life-threatening injuries within the superior mediastinum and intrathoracic cavity; therefore, they are considered true orthopedic emergencies and should be reduced expeditiously. Reported complications associated with posterior sternoclavicular dislocations include compression or lacerations of the great vessels, tracheal compression, pneumothorax, thoracic outlet syndrome, tracheoesophageal fistula, and injury to the brachial plexus.

**46.2.** A 30-year-old patient presents complaining of right shoulder pain and limited range of motion. On physical examination, you note that the shoulder has a “squared off” appearance and is held in abduction and external rotation. The patient is unable to adduct the arm or internally rotate without severe pain. What is the best way to manage this patient without the aid of other emergency department (ED) personnel?

- A. Anderson method
- B. Hippocratic method
- C. Kocher maneuver
- D. Milch technique
- E. Traction/countertraction method

**Answer: D.** The ideal method for reduction of an anterior shoulder dislocation should be simple, quick, and effective; require little assistance; and cause no additional injury to the shoulder. It is wise to be familiar with several techniques of reduction because none is uniformly successful. The Milch technique allows for reduction by a single practitioner, and it can be attempted without procedural sedation. More traditional techniques, such as the Hippocratic method (traction with the foot in the axilla) and the Kocher maneuver (leverage, adduction, and internal rotation), are no longer recommended because of a high incidence of associated complications (axillary nerve injury, humeral shaft and neck fractures, and capsular damage). Traction/countertraction requires two people to reduce the shoulder, and there is no reduction technique called the Anderson method.

**46.3.** Urgent orthopedic consultation is recommended for which type of clavicle fracture?

- A. Greenstick fracture
- B. Minimally displaced midclavicular fracture
- C. Type I lateral clavicle fracture
- D. Type II lateral clavicle fracture
- E. Type III lateral clavicle fracture

**Answer: D.** Type I lateral clavicle fractures are stable and minimally displaced because the coracoclavicular ligaments are intact. Type II fractures are associated with a torn coracoclavicular ligament and have a tendency to displace because the proximal fragment lacks any stabilizing forces. Type III injuries involve the articular surface. More urgent orthopedic consultation (before 72 hours) is recommended for type II lateral clavicle fractures, because these fractures have up to a 30% incidence of nonunion and may benefit from surgical repair.

## KEY CONCEPTS

- Most back pain presenting to the emergency department (ED) is benign, self-resolving with conservative therapy, and does not require imaging.
- Indications for emergent imaging include history of malignancy, new significant neurologic deficit, bowel or bladder dysfunction or saddle anesthesia, intravenous (IV) drug use, fever, immunocompromised state, chronic steroid use, and anticoagulant use.
- Metastatic disease is more common than primary tumors in the spine, and thoracic metastases are more common than lumbar metastases.
- Epidural abscess or hematoma, cauda equina syndrome (CES), spinal malignancy with compressive symptoms, and spinal osteomyelitis are indication for emergent surgical consultation or transfer to a center where emergent surgical consultation is available.
- Empirical parenteral antibiotics active against staphylococci, streptococci, and gram-negative bacilli should be administered for suspected epidural abscess. Antibiotics should be directed against the known pathogen if the culture or Gram stain of the aspirate is positive.
- Corticosteroids given as a single dose in the ED (10 mg dexamethasone) or as a 15-day tapering course after discharge (prednisone 60 mg, 40 mg, 20 mg daily for 5 days) may improve functional ability but do not improve pain for patients with nerve root findings related to disc herniation.
- Corticosteroids are of no proven benefit for patients with CES. We recommend that corticosteroids not be used for patients with suspected or known CES unless desired by the treating spine surgeon.

## CHAPTER 47: QUESTIONS &amp; ANSWERS

**47.1.** A 55-year-old man presents with the complaint of low back pain for 1 month. The pain is worse at night and is associated with a 10-pound weight loss. He denies any radicular symptoms. Which of the following is the most likely cause of this man's back pain?

- A. Chordoma
- B. Lymphoma
- C. Multiple myeloma
- D. Osteosarcoma
- E. Sciatica

**Answer: B.** The patient's subacute time course of back pain and worrisome finding of weight loss suggest a malignancy. Primary and metastatic bone neoplasms can cause back pain from tumor infiltration into the bone. Primary bone tumors, such as multiple myeloma, chordoma, Ewing's sarcoma, and osteosarcoma, are 25 times less frequent than metastatic disease. Of the neoplasms, breast, lung, prostate, thyroid, lymphoma, and kidney are the most likely to metastasize to bone.

**47.2.** Which one of the following indicates a benign presentation of back pain?

- A. Low back pain and fever
- B. Low back pain and saddle anesthesia
- C. Low back pain in a 6-year-old child
- D. Low back pain with a negative sitting but a positive supine straight leg raise (SLR) test
- E. Low back pain with post-void residual of 500 mL

**Answer: D.** A positive supine SLR test but a negative sitting SLR test suggests a nonphysiologic cause for the pain. Low back pain and fever suggest an epidural abscess or spondylitis. Saddle anesthesia and post-void residual greater than 100 mL are indicative of cauda equina syndrome (CES). Children complaining of back pain must be investigated. They may have spondylolysis with varying degrees of spondylolisthesis, Scheuermann's disease (kyphosis and osteochondritis of the vertebral end plates), infectious diseases, or neoplastic etiologies.

**47.3.** The adult spinal cord usually ends at which level?

- A. L1 to L2
- B. L3 to L4
- C. L5 to S1
- D. S2 to S3
- E. Coccyx

**Answer: A.** The spinal cord ends at around L2 in adults, lower in children. Remember that between individuals, there may be significant anatomic variance.

**47.4.** A 55-year-old man complains of low back pain when walking downhill that is relieved with walking uphill. His neurovascular examination is unremarkable except for decreased bilateral Achilles reflexes. What is the appropriate management of this patient?

- A. Lumbosacral radiographs
- B. Magnetic resonance imaging (MRI)
- C. Pain management and bed rest
- D. Pain management and emergent surgical consultation
- E. Pain management and surgical referral for pseudoclaudication

**Answer: E.** This patient presents with typical complaints of spinal stenosis. Patients with spinal stenosis should be managed conservatively with pain medications. In the absence of alarming red flag findings, these patients do not require laboratory or radiographic studies in the emergency department (ED). These patients may be candidates for surgery if they show any of the following conditions: progressive neurologic deficit, progressive reduction in ability to walk secondary to pseudoclaudication, evidence of cauda equina syndrome (CES), or intractable pain.



- 47.5. Which of the following statements regarding cauda equina syndrome (CES) is false?
- A. Hallmarks are saddle anesthesia and urinary retention
  - B. Is often caused by a central disk herniation
  - C. Is most often associated with a post-void urinary residual of 75 mL or less
  - D. Requires emergency surgical decompression
  - E. Usually compresses bilateral nerve roots

**Answer: C.** The most consistent examination finding in CES is urinary retention. With a high sensitivity of 90%, the patient is unlikely to have this disease process if his or her post-void residual urine volume is less than 100 to 200 mL. Saddle anesthesia (sensory deficit over the buttocks, upper posterior thighs, and perineal area) is frequently an associated finding, with a sensitivity of 75%. In 60% to 80% of cases, the rectal examination reveals a decreased sphincter tone.

- 47.6. A 42-year-old man presents to the emergency department (ED) with a 12-day history of low back pain after an episode of heavy lifting at work. He reports bilateral low back pain at the level of the iliac crests. He denies sensory or motor symptoms. He also denies bowel or bladder dysfunction. His neurologic examination is normal. For this patient, which are the most important treatments and recommendations?
- A. Lumbar MRI
  - B. Lumbar MRI, complete blood count (CBC), and erythrocyte sedimentation rate (ESR)
  - C. Obtaining lumbar radiographs with anteroposterior, lateral, and oblique views
  - D. Placement on strict bed rest for 4 weeks
  - E. Treatment with symptomatic medication and return to light activity

**Answer: E.** The patient most likely suffers from idiopathic low back pain. This is also commonly called *acute lumbosacral strain*. Most patients with this injury should not be placed on bed rest and should be allowed to return to normal activity, possibly with some restrictions. The patient has a relatively short history of low back pain with clear onset around an episode of lifting. Given a lack of concerning historical or examination findings, the patient does not require imaging at this time. Blood work would not be of help in evaluating the patient, because he lacks history or examination findings consistent with spinal infection.

- 47.7. A 35-year-old woman presents with a 3-day history of severe right lower extremity pain associated with mild low back pain. Her neurologic examination is normal except for a positive straight leg raise (SLR) test on the right and a negative cross straight leg raise (CSLR) test on the left. What is the most likely source of this patient's symptoms?
- A. Acute lumbosacral strain
  - B. Ankylosing spondylitis
  - C. Lumbar disk herniation with radiculopathy
  - D. Spinal epidural abscess
  - E. Spinal malignancy

**Answer: C.** Patients with herniated lumbar disks often present with radicular leg pain that overshadows the complaint of back pain. It is very common for a patient with lumbar radiculopathy to have no clear motor or sensory deficit but have exacerbation of leg pain with SLR testing. The SLR has high sensitivity but low specificity. In contrast, the CSLR test has high specificity but low sensitivity. Given this, it is common for the patient with lumbar disk herniation to have a positive SLR but negative CSLR. The reverse is very uncommon. Diagnoses (such as, spinal epidural

abscess and spinal malignancy) usually present with prominent low back pain that is more significant than extremity pain.

- 47.8. A 68-year-old man presents with a 5-week history of worsening low back pain. He reports mostly midline spinal pain with occasional radiation into both lower extremities. Two weeks before the onset of his pain, he was discharged from the hospital after an inpatient stay for pneumonia. On examination, he has intact lower extremity motor and sensory function but tenderness to percussion over the lumbar spine. Initial evaluation of the patient is most likely to reveal which of the following?
- A. Lumbar computed tomography (CT) showing degenerative spondylolisthesis at L4 to L5
  - B. Lumbar magnetic resonance imaging (MRI) showing unilateral L4 to L5 disk herniation
  - C. Lumbar MRI showing very large central disk herniation at L4 to L5 with compression of the cauda equina
  - D. White blood cell (WBC) count of 9000 and erythrocyte sedimentation rate (ESR) of 58
  - E. WBC count of 22,000 and ESR of 4

**Answer: D.** The patient's history is suspicious for spinal epidural abscess. He is at higher risk because of his age and recent infection. In addition, the patient has tenderness with percussion of his spine. Patients with epidural abscess usually have an ESR elevated above 20 mm/hr. However, it is not uncommon for them to have a normal or only mildly elevated WBC count. It would be uncommon for the patient to have an elevated WBC count but normal ESR. Lumbar disk herniation is rarely associated with spinal tenderness to percussion. A large central disk herniation with bilateral nerve root compression would likely present with lower extremity symptoms. Degenerative spondylolisthesis at L4 to L5 would likely be an asymptomatic problem.

- 47.9. A 63-year-old man presents with a 9-month history of progressive low back pain with ambulation. He reports significant pain in his buttocks and posterior thighs when he walks distances greater than 25 meters. He says the pain is partially relieved when he flexes forward and completely relieved by recumbency. He reports the pain is not relieved if he stops walking but remains standing. On neurologic examination, he has intact lower extremity strength but diminished Achilles reflexes bilaterally. Other likely findings include which of the following?
- A. Diminished posterior tibial and dorsalis pedis pulses
  - B. Lumbar magnetic resonance imaging (MRI) revealing right L5 to S1 disk herniation
  - C. Lumbar MRI revealing spinal stenosis at L4 to L5 and L5 to S1
  - D. Normal lumbar MRI
  - E. Thoracic MRI revealing significant T5 to T6 disk herniation with spinal cord compression

**Answer: C.** The patient presents with classic findings of spinal stenosis and neurogenic claudication or "pseudoclaudication," including relief with flexing forward and recumbency. Persistence of pain with standing despite having stopped ambulating is also indicative of neurogenic claudication, as are diminished Achilles reflexes. Diminished pulses are indicative of vascular claudication. Pain from vascular claudication is generally relieved if a patient stops walking but remains standing. Unilateral disk herniation does not usually present with bilateral lower extremity symptoms. Spinal cord compression from T5 to T6 disk herniation would cause myelopathy and generally present with gait unsteadiness and hyperreflexia but not pain.

## KEY CONCEPTS

- The most serious pelvic ring injuries caused by high-energy impact are (1) anteroposterior compression fractures ("open-book" fracture), (2) vertical shear fractures, and (3) fractures involving significant displacement. These injuries are associated with major blood loss and transfusion requirements.
- Pelvic injury is a marker for serious injury to other organ systems. The vast majority of patients who die after sustaining a pelvic fracture have multiple trauma.
- Careful examination of the perineum and buttocks, as well as digital rectal and vaginal examinations, are necessary to diagnose open fractures.
- Computed tomography (CT) is the imaging test of choice to diagnose pelvic fracture and concurrent intra-abdominal injuries for patients stable enough to undergo the scan. CT aids in establishing surgical priorities and planning of definitive orthopedic care. The significance of contrast extravasation during CT imaging is a subject of ongoing research regarding the ability to distinguish between arterial and venous sources of pelvic bleeding.
- In the hemodynamically unstable patient who cannot undergo CT imaging, the anteroposterior radiograph usually reveals serious pelvic fractures that cause major pelvic bleeding, which is sufficient information to undertake pelvic stabilization if indicated.
- The combination of posterior arch fracture plus hypotension is associated with a mortality rate of approximately 50%.
- Early fluid resuscitation with blood products is recommended for patients suspected of having active pelvic bleeding.
- Trauma hospitals should have institutional guidelines and mechanisms to facilitate early decisions regarding the treatment for pelvic hemorrhage. Treatment options include angiography and embolization, pelvic packing, invasive fixation, or any combination of these therapies.
- Unstable patients with a positive FAST and a pelvic fracture should be treated with laparotomy with pelvic stabilization and possible pelvic packing, and then angiography.
- Unstable patients with a negative FAST and a pelvic fracture should be treated with pelvic stabilization (eg, a pelvic binder) and angiography, and then a repeat FAST and laparotomy if they remain unstable.
- "Open-book" pelvis fractures should be internally compressed with a pelvic binder or sheet to reduce the size of the pelvis, unless the fracture forces have already internally rotated the hemipelvis as this could cause an increase in the pelvic diameter.

## CHAPTER 48: QUESTIONS &amp; ANSWERS

**48.1.** While examining a patient with blunt abdominal trauma, you note blood at the urethral meatus. What is the most appropriate next step in the patient's management?

- A. Order a cystography
- B. Order a retrograde urethrogram
- C. Order a urinalysis
- D. Order an anterograde urethrogram
- E. Order an intravenous pyelography

**Answer: B.** Blood at the urethral meatus necessitates a retrograde urethrogram followed by a cystogram. Gross hematuria is investigated by a combination of urethrography, intravenous pyelography, cystography, and computed tomography (CT).

**48.2.** An avulsion fracture caused by the rectus femoris muscle most likely involves which of the following structures?

- A. Anterior inferior iliac spine
- B. Anterior superior iliac spine
- C. Iliac crest
- D. Ischial tuberosity
- E. Sacrum

**Answer: A.** Forceful contraction of the rectus femoris (as in kicking a ball) can result in an injury of anterior inferior iliac spine avulsion. The ischial tuberosity may be avulsed during strenuous contraction of the hamstrings. A portion of the iliac crest epiphysis may be avulsed by contraction of the abdominal muscles. The anterior superior iliac spine may be avulsed by forceful contraction of the sartorius muscle.

**48.3.** A 25-year-old patient involved in a motor vehicle collision (MVC) presents with a suspected unstable pelvic fracture. Vital signs are: blood pressure, 90/50 mm Hg; heart rate, 120 beats per minute; and respiratory rate, 22 breaths per minute. What is the most appropriate next step in this patient's management?

- A. Call trauma service for immediate laparotomy
- B. Call orthopedics for fixation
- C. Chest, abdominal, and pelvis radiographs
- D. Computed tomography (CT) scan of the abdomen and pelvis
- E. Perform serial abdominal and focused assessment with sonography in trauma (FAST) examinations

**Answer: C.** The addition of inlet and outlet views of the pelvis has been shown to increase the sensitivity and specificity of plain radiographs in detecting significant pelvic fracture. When patients are too unstable to undergo CT investigation, the anterior/posterior portable radiograph is useful in screening for pelvic injuries that are most associated with major blood loss. Findings with this technique that have been reported to predict the need for transfusion include "open-book" fracture or displacement of 0.5 cm or more at any fracture site in the pelvic ring, and displaced symphysis pubis or obturator ring fracture.

**48.4.** Which of the following treatments can provide definitive control of hemorrhage from severe pelvic fracture?

- A. Blood transfusion
- B. Commercial circumferential pelvic compression devices
- C. External fixation
- D. Transfusion of concentrated clotting factors
- E. Wrapping pelvis with sheet

**Answer: C.** External fixation is an invasive strategy aimed at cessation of pelvic hemorrhage. Options A and E are important for the emergency clinician to quickly stabilize a mechanically unstable pelvic fracture and hopefully minimize bleeding, but these options, per se, are not definitive treatments. Transfusion of blood products is important in overall resuscitation of the patient but does not stop bleeding from pelvic fractures.

**48.5.** Which of the following radiographic findings necessitates further evaluation of the pelvic ring?

- A. Asymmetry of the pelvis caused by rotation
- B. Duverney fracture
- C. Sacroiliac joint 4 mm wide on pelvic radiograph
- D. Symphysis pubis 7 mm wide
- E. Transverse fracture of the sacrum

**Answer: D.** On the anteroposterior radiograph, the symphysis pubis is normally no more than 5 mm wide, and a small (1 or 2 mm) vertical offset of the left and right pubic rami may be normal. Normally, the sacroiliac joint is approximately 2 to 4 mm wide. On the anteroposterior view, the physician may judge the degree of pelvic rotation caused by technique and positioning by the presence of asymmetry.

## KEY CONCEPTS

- Hip dislocation is an orthopedic emergency. The likelihood of avascular necrosis (AVN) is related to both the initial degree of trauma and the amount of time the femoral head remains out of joint. Reduction of the hip within 6 hours after dislocation significantly decreases the incidence of AVN.
- When a painful hip makes ambulation difficult and plain radiographs do not reveal a fracture, computed tomography (CT) or magnetic resonance imaging (MRI) should be performed. MRI is the gold standard for diagnosis.
- In patients with intertrochanteric fractures, hemodynamic instability can result from dehydration and blood loss. Up to 70% of patients with these injuries are under-resuscitated.
- It is important to identify acetabular fractures before closed reduction is attempted, because intra-articular bone fragments can interfere with effective reduction.
- In elderly patients, the use of femoral nerve blocks should be considered due to the adverse effects of parenteral opioids.

## CHAPTER 49: QUESTIONS &amp; ANSWERS

**49.1.** Which of the following fractures has the best outcome and lowest rate of complications?

- A. Femoral neck fracture
- B. Insufficiency fracture
- C. Intertrochanteric fracture
- D. Lesser trochanteric fracture
- E. Subtrochanteric fracture

**Answer: D.** Treatment of a lesser or greater trochanteric fracture consists of pain control and early mobilization with crutches; weight bearing is allowed as tolerated by pain. Outpatient management of this injury is possible with a satisfactory social situation. The prognosis is good, and healing is generally excellent. The mortality rate during the first year after a femoral neck (also known as an *insufficiency fracture*) fracture is 14%. Intertrochanteric fractures have an associated mortality rate of 10% to 30% in the first year. The reported mortality rate from subtrochanteric fractures ranges from 9.6% to 13.3%.

**49.2.** A 40-year-old man complains of persistent thigh pain that worsens over 2 weeks after an assault with a baseball bat. His pain is worse with knee extension. On physical examination, you note that there is a small palpable mass at the midanterior thigh. What should be your next confirmatory test?

- A. Bone scan for fracture
- B. Bone scan for stress fracture
- C. Computed tomography (CT) scan for tumor
- D. Magnetic resonance imaging (MRI) for evaluation of torn muscle
- E. Radiograph for heterotrophic calcification

**Answer: E.** Myositis ossificans (heterotrophic ossification) is pathologic bone formation at a site where bone is not normally found. Traumatic myositis ossificans results most commonly from a direct blow to muscle. It should be suspected when symptoms persist past 10 to 14 days or if symptoms intensify several weeks after the trauma. The ossific mass is often palpable and may limit motion, depending on its location.

**49.3.** An 80-year-old woman presents complaining of pain in her right leg after a motor vehicle collision (MVC). Emergency medical services (EMS) noted a swelling and a deformity to her thigh, so they placed a traction device on her leg. Her vital signs are: blood pressure, 80/40 mm Hg; heart rate, 110 beats per minute; and respiratory rate, 18 breaths per minute. What is the most appropriate next step in the management of the patient's fracture?

- A. Femoral nerve block and leave the traction device in place
- B. Femoral nerve block and remove the traction device
- C. Intravenous morphine and leave the traction device in place
- D. Intravenous narcotic pain medication and remove the traction device
- E. Immediate orthopedic consult to take the patient to the operating room for an open reduction and internal fixation (ORIF)

**Answer: B.** Although the patient may ultimately need to go to the operating room, the patient is currently unstable and requires resuscitation and evaluation for other injuries. A femoral nerve block is invaluable as an adjunct or alternative to systemic analgesics in a patient at risk for hypotension and has been underused by emergency clinicians. Prolonged traction during the assessment and management of other injuries can cause or worsen serious neurologic injury in the thigh by producing potentially damaging tension on the sciatic and/or femoral nerves.

**49.4.** What is the most common complication of a proximal femur fracture?

- A. Avascular necrosis (AVN)
- B. Myositis ossificans
- C. Osteomyelitis
- D. Pulmonary embolism
- E. Septic arthritis

**Answer: A.** AVN is the most common complication of proximal femur fractures (despite optimal treatment) because of the complex arterial anatomy. Deep infection in the form of osteomyelitis or septic arthritis is more common with femoral neck fractures because the fracture line extends into the joint. Pulmonary embolism is another significant complication and is the leading cause of death 7 days after fracture in all orthopedic patients.

**49.5.** A 60-year-old woman presents complaining of right hip pain after a trip and fall at home. The patient denies loss of consciousness or other symptoms. You note that the patient's right leg is internally rotated, and the thigh is adducted and flexed at the hip joint so that the ipsilateral knee is resting on the opposite thigh. Which is the correct maneuver?

- A. Apply traction and splint the leg in full extension.
- B. Apply traction to an extended knee and flexed hip at 90 degrees with a gentle rotational component.
- C. Consult orthopedics immediately to take the patient to the operating room.
- D. Provide analgesia and Holter monitor for discharge when ambulatory.
- E. Use the Allis maneuver and place the patient in a knee immobilizer.

**Answer: E.** A patient with a posterior dislocation typically holds the hip flexed, adducted, and internally rotated. The knee of the affected extremity rests on the opposite thigh. The Allis technique is usually effective for both posterior and obturator dislocations. With the knee flexed, the operator applies steady traction in line with the deformity. The hip is slowly brought to 90 degrees of flexion while steady upward traction and gentle rotation are applied.



- 49.6. A mother brings her 11-year-old boy for evaluation of left knee pain that is worse after physical activity. Radiographs of the knee were negative. What is the most appropriate next step in the patient's management?
- A. Hip radiograph with frog-leg views
  - B. Joint aspiration for evaluation of transient synovitis
  - C. Place a knee immobilizer and ensure follow-up in 1 week
  - D. Radiograph of right knee for comparison
  - E. Rest, ice, compression, elevation, and orthopedic follow-up urgently

**Answer: A.** This patient may have a slipped capital femoral epiphysis (SCFE), which most commonly develops in boys 10 to 17 years old during their period of rapid growth. Referred pain to the knee is a classic manifestation, and patients frequently present with groin, thigh, or knee pain rather than hip pain. Initially, anteroposterior, lateral, and frog-leg lateral radiographs of the hip should be obtained. The frog-leg lateral projection shows the hip in a plane midway between the anteroposterior and lateral views.

- 49.7. A 75-year-old woman presents after a fall from standing. She has right hip pain and tenderness to palpation but no obvious deformity. Right knee and ankle examinations are normal, without tenderness, deformity, or external signs of trauma. Hip and pelvis radiographs are negative for fracture, but the patient is unable to bear weight on her right leg. The next appropriate step in management is:
- A. Admit to the hospital for bed rest.
  - B. Discharge patient home with analgesia and a walker.
  - C. Obtain magnetic resonance imaging (MRI) of the hip to assess for fracture not identified by radiographs.
  - D. Obtain radiographs of the rest of her right leg to ensure no occult fracture is present.

**Answer: C.** With hip injury, if radiographs do not show a fracture or suggestion of injury and the patient is unable to ambulate, further imaging studies should be obtained to evaluate for occult fracture. Two percent to 10% of all hip fractures are radiographically occult. Failure to detect these fractures results in increased morbidity and mortality.

- 49.8. Which of the following injuries is appropriate for traction splinting by prehospital providers?
- A. Femoral fracture with bone protrusion through skin
  - B. Posterior hip dislocation
  - C. Severe crush injury of leg with obvious deformity of the knee
  - D. Suspected closed mid shaft femoral fracture

**Answer: D.** Traction splints can provide pain relief, immobilization, and limit blood loss when applied correctly to a femoral fracture. However, contraindications to the use of traction splints include pelvic fractures, patellar fractures, ligamentous knee injuries, and tibia or fibula fractures. Traction in the prehospital setting should not be applied to any open fracture that has exposed bone. Such reduction pulls grossly contaminated bone fragments back into the wound before adequate débridement can be undertaken in the operating room.

- 49.9. A 15-year-old female gymnast presents after experiencing the sudden onset of severe groin pain during a dismount when she landed in a flexed hip position. The pain radiates into her abdomen, and flexion of the hip produces pain, but there is no deformity noted. What is the most likely radiographic finding?
- A. Avascular necrosis (AVN) of the femoral head noted on magnetic resonance imaging (MRI) scan
  - B. Diastasis of the pubic symphysis on anteroposterior pelvis radiographs
  - C. Femoral neck fracture on dedicated anteroposterior hip radiograph
  - D. Iliopsoas muscle with some associated hemorrhage on computed tomography (CT) scan

**Answer: D.** Gymnasts and dancers are the group of athletes most likely to experience an injury to the iliopsoas as a result of sudden forceful hip flexion against resistance. Severe pain often is experienced in the groin, thigh, or low back region. Severe intra-abdominal pain is common at the muscle origin and may dominate the clinical picture. Examination reveals groin tenderness and pain with active hip flexion. Radiographs of the femur should be obtained to identify an avulsion fracture of the lesser trochanter. CT scan frequently will demonstrate a large hematoma. Bed rest with partial flexion at the knee and hip generally is required for 7 to 10 days. With severe strains, symptoms may persist for 2 to 3 months. Referral to a sports medicine specialist is appropriate.

- 49.10. A 45-year-old male presents with a posterior hip dislocation after a motor vehicle crash (MVC) noted on radiographs. After sedation of the patient and reduction of the dislocated hip, what is the most appropriate next step in the patient's management?
- A. Have the patient ambulate to assess the stability of the joint.
  - B. Measure the femoral compartment pressure.
  - C. Obtain postreduction hip radiographs to assess for additional injuries and adequate reduction.
  - D. Place a traction splint.

**Answer: C.** Obtaining postreduction radiographs to ensure adequate reduction and evaluate for associated injuries is essential. After closed reduction, the hip should be tested for stability, which is accomplished by gently taking it through a full range of motion to see whether it will re-dislocate. After testing has ensured stability, the injured extremity should be placed in a knee immobilizer, and an abduction pillow should be applied to prevent repeat dislocation.

## KEY CONCEPTS

- Knee dislocation often causes vascular injury to the popliteal artery. Early revascularization is crucial. Hard signs of vascular injury include absent pedal pulses, cool mottled foot, expanding popliteal hematoma, or popliteal hemorrhage. When any of these are present, angiography or surgical exploration is indicated.
- Soft signs of popliteal artery injury include asymmetric pedal pulses and dorsolateral foot or leg paresthesias. CT angiography or duplex ultrasound study is indicated when these are present.
- In the absence of signs of popliteal injury, the knee dislocation patient can be observed for 24 hours, with measurement of the ankle-brachial index (ABI) every 3 hours. An ABI persistently over 0.9 for 24 hours effectively excludes significant popliteal artery injury.
- Patella dislocation is common, examination reveals the dislocated patella fixed in a position superolateral to its normal position, and reduction is by gentle knee extension with medial pressure on the displaced patella. In contrast, in patellar tendon rupture, the patella rides high (patella alta), is not laterally displaced, and is mobile, and the patient is unable to extend the knee.
- Injuries to the cruciate and collateral ligaments may not be detectable on initial examination because of effusion and splinting. Emergent diagnosis is not necessary, but the patient should undergo a follow-up examination by an orthopedist.
- Lipohemarthrosis is an uncommon and subtle sign of occult fracture and should be sought on radiographs of traumatized knees.
- Compartment syndrome is a serious complication of tibial shaft fracture, usually occurring 24 to 48 hours after injury. Orthopedic consultation or measurement of compartment pressure should be undertaken when the patient's pain is increasing, despite immobilization and support of the fracture.

## CHAPTER 50: QUESTIONS &amp; ANSWERS

- 50.1.** A 45-year-old woman presents after a high-impact motor vehicle collision with pain in the left knee. The distal neurovascular examination is intact. What is the most appropriate management?
- A. Compression wrap and early range-of-motion exercises
  - B. Discharge if radiographs are negative with partial weightbearing
  - C. Knee immobilizer with orthopedic follow-up
  - D. Measure ankle-brachial index and perform duplex ultrasonography if less than 0.9
  - E. Orthopedic consultation

**Answer: D.** This patient had a knee dislocation. Knee dislocation is uncommon but should be considered in the setting of an appropriate injury mechanism because 50% of all knee dislocations are reduced spontaneously before emergency department (ED) arrival. Reduction before ED arrival does not lessen the likelihood of vascular injury, and vascular injury should be considered in patients with severe ligamentous injuries and injuries caused by high-energy mechanisms. Vascular injury to the popliteal artery is the most severe complication and is the major cause of morbidity and limb loss. Management of suspected knee dislocation involves an algorithm designed to be noninvasive but sensitive for arterial injury.

- 50.2.** A 42-year-old man was at the gym performing squatting exercises. As he was coming to a stand, he had an immediate onset of pain in his right thigh. He presents with an inability to extend his knee. What is the most likely physical finding?
- A. High-riding patella
  - B. Midquadriceps muscle tenderness and deformity
  - C. Popliteal swelling and tenderness
  - D. Positive Lachman's test
  - E. Suprapatellar tenderness with patella baja

**Answer: E.** This is a quadriceps tendon rupture. Patients with extensor disruption may have signs and symptoms that include an acute onset of pain, swelling, ecchymoses over the anterior aspect of the knee, a palpable defect in the patella, quadriceps tendon, or patella tendon loss or limited ability for active leg extension; extension lag usually is seen when the last 10 degrees of extension are performed haltingly or with difficulty. With quadriceps rupture, a low-riding patella (patella baja) and inferior retraction may be seen.

- 50.3.** A college football lineman presents complaining of left knee pain and inability to bear weight. He was on the scrimmage line when the ball was placed in motion and, as he lunged forward, he twisted his leg and heard an audible pop in his knee. He was immediately unable to bear weight. On physical examination, you find the left knee swollen, with moderate joint line tenderness and a positive pivot shift test. What is the most sensitive way to diagnose the injury accurately?
- A. Arthroscopy of the knee
  - B. Computed tomography (CT) scan of the knee
  - C. History and physical examination
  - D. Magnetic resonance imaging (MRI) of the knee
  - E. Plain radiography of the knee

**Answer: A.** Clinical evaluation is moderately sensitive for ACL tears but, in the acute phase, is often inaccurate because of swelling and splinting. Acutely, only plain films are indicated as long as dislocation is not suspected. Tibial plateau fractures detected on plain film may require CT to determine the need for admission for early operative repair. Arthroscopy is the gold standard for diagnosis of soft tissue injuries of the knee. MRI is useful but may miss small tears and anatomic abnormalities, and a normal study may still lead to arthroscopy if symptoms persist. MRI scanning of the knee is rarely indicated in the acute setting.

- 50.4.** A man presents with severe pain of his right lower leg. He was in the ED the previous night for splint placement for a tibial fracture. After removal of the splint, you see a lower leg with mild ecchymosis, healing abrasions, and palpable posterior tibial and dorsalis pedis pulses. He has severe pain on passive movement of his first toe and decreased sensation of the first toe web space. Which of the following should be the next step?
- A. Admit for IV antibiotics and pain control.
  - B. Obtain venous Doppler scans.
  - C. Resplint the patient.
  - D. Test the anterior compartment pressures.
  - E. Test the superficial posterior compartment pressures.

**Answer: D.** The lower leg is divided into the following compartments by deep partitions of the investing crural fascia—anterior, lateral, superficial posterior, and deep posterior. The anterior compartment contains the tibialis anterior, long toe extensor muscles, anterior tibial artery, and deep peroneal nerve, which supplies sensation to the first web space of the foot.



**50.5.** A severe medial ankle sprain with no ankle fracture necessitates evaluation of which of the following?

- A. Cervical spine
- B. Femoral nerve
- C. Lumbar spine
- D. Popliteal artery
- E. Proximal fibula

**Answer: E.** An important exception to fibular fractures being stable is a Maisonneuve fracture (see [Fig. 50.13](#)). This involves a medial ankle disruption (deltoid ligament tear or medial malleolar fracture), with complete tearing of the syndesmotic ligament joining the tibia and fibula and fracture of the proximal fibula. This results in an unstable ankle mortise because the fibula now floats free relative to the tibia, and surgical fixation is required.

**50.6.** A 14-year-old boy presents with right knee pain that is worse with physical activity. He has swelling of the inferior aspect of the knee, with point tenderness below the patella, along the patellar tendon, and on the tubercle. Radiographs do not demonstrate a fracture. What is your next step in managing this patient?

- A. Admission for repeat serology and physical examinations
- B. Discharge if complete blood count (CBC), erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) level are normal
- C. Emergent orthopedic consultation
- D. Knee brace and crutches
- E. Rest, ice, and pain management

**Answer: E.** This patient has Osgood-Schlatter disease. Treatment varies according to the acuteness of the symptoms and skeletal age of the patient. Initially, rest, ice, and analgesics are the mainstays of therapy. As symptoms subside, a rehabilitation program that stretches and strengthens the quadriceps should be instituted. Knee orthoses are used to dampen the pull of the extensor mechanism on the weakened tibial apophysis. Immobilization is reserved for the unreliable patient who will not or cannot comply with the program of relative rest in which aggravating activities are avoided.

## KEY CONCEPTS

- The Ottawa Ankle and Foot Rules should be used to evaluate for the need for x-rays in ankle and foot injuries.
- CT scans are indicated for negative x-rays of the ankle and foot when a high clinical concern of fracture exists.
- Ankle dislocations with obvious vascular compromise should be reduced promptly, before radiographs are obtained.
- The entire fibula should be examined if an isolated medial malleolar fracture is present to rule out a proximal fibular (Danis-Weber type C or Maisonneuve) fracture.
- Osteochondral lesions of the talar dome, nondisplaced fractures of the lateral posterior process of the talus, and fracture of the anterior process of the calcaneus are important to include in the differential diagnosis of presumed ankle sprains.
- Patients discharged with a diagnosis of ankle sprain should be encouraged to seek outpatient follow-up should ankle pain and swelling persist for longer than 2 weeks.
- Patients with Achilles tendon rupture are still capable of weak plantar flexion. Ultrasound may be used to confirm the diagnosis if clinical uncertainty exists.
- A Lisfranc injury should be considered with any fracture or dislocation in the tarsometatarsal region, particularly with fractures of the second metatarsal base. When suspicion for a Lisfranc injury is high, and plain radiographs and CT scans are negative, immobilization and orthopedic referral are indicated.
- Fifth metatarsal tuberosity (zone 1) fractures should be carefully differentiated from diaphyseal fractures. Orthopedic referral is indicated for zones 2 and 3 fractures.
- Stress fracture should be considered in patients with long-standing foot pain, particularly if symptoms are in the metatarsal region. This may be diagnosed by plain radiography, CT scanning, or radionuclide bone scanning.
- Compartment syndrome may occur in any of the four major compartments of the foot. Diagnosis is by measurement of the intracompartment pressure.

## CHAPTER 51: QUESTIONS &amp; ANSWERS

51.1. A middle-aged farmer presents after an accident with a plow with a crushed open distal tibia fracture. What is the appropriate antibiotic choice?

- A. Cefazolin
- B. Cefazolin and gentamycin
- C. Cefazolin, gentamycin, and penicillin G
- D. Ciprofloxacin
- E. Pen VK and cephalixin

**Answer: C.** Because the patient has a probable soil contaminant in his open fracture, he will need the addition of penicillin G to cover *Clostridium perfringens*. For low-energy injuries with mild to moderate contamination, a broad-spectrum cephalosporin is usually sufficient. Heavily contaminated wounds require the addition of gram-negative bacterial coverage, typically with an aminoglycoside. Adding penicillin G as a third antibiotic is necessary for farm- or soil-related crush injuries.

51.2. A 30-year-old woman complains of pain in the ankle and difficulty walking after attempting a jump shot while playing basketball. Her past medical history includes a recent urinary tract infection, for which she is taking ciprofloxacin. On physical examination, her ankle joint is not swollen, there is a palpable defect 4 cm proximal to the posterior ankle, and she has weakened plantar flexion. Which of the following is true concerning her condition?

- A. Boehler's angle should be less than 20 degrees.
- B. In a seated position, squeezing the calf causes foot dorsiflexion.
- C. It requires a stress radiograph view.
- D. On the radiograph, there may be an opacification at Kager's triangle.
- E. Talofibular ligament laxity is present.

**Answer: D.** The patient has a ruptured Achilles tendon. On examination, a visible and palpable tendon defect 2 to 6 cm proximal to the calcaneal insertion may be present. In some cases of complete Achilles tendon rupture, weak plantar flexion may still be present because of the actions of the tibialis posterior, toe flexors, and peroneal muscles. When the Achilles tendon is intact, squeezing the calf muscles should cause passive plantar flexion of the foot (Thompson test). Lateral radiographs of the ankle may confirm rupture by showing opacification of the triangular fatty tissue-filled space anterior to the Achilles tendon (Kager's triangle) or an irregular contour and thickening of the tendon.

51.3. A 24-year-old patient presents with pain in the left foot after a twisting injury. On physical examination, you find no point tenderness on the medial or lateral distal 6 cm of the malleoli, no proximal fibular tenderness, and no navicular tenderness. Which of the following physical findings would necessitate radiographs being taken in the emergency department?

- A. Inability to ambulate to the car
- B. Laxity on anterior drawer testing
- C. Moderate swelling with ecchymosis
- D. Tenderness at the base of the fifth metatarsal
- E. Tenderness over the deltoid ligament

**Answer: D.** The Ottawa Ankle Rules advise ankle radiographs when any of the following are present: tenderness at the posterior edge of the distal 6 cm or tip of the lateral malleolus, tenderness at the posterior edge of the distal 6 cm or tip of the medial malleolus, or inability to bear weight for at least four steps immediately after the injury and at the time of evaluation. Foot radiographs in the setting of blunt ankle trauma are advised when any of the following are present: tenderness over the navicular, tenderness at the base of the fifth metatarsal, or inability to bear weight for at least four steps immediately after the injury and at the time of evaluation.

51.4. In what order are ligaments injured with inversion ankle injuries?

- A. Anterior talofibular, calcaneofibular, and lateral talocalcaneal ligaments
- B. Anterior talofibular, posterior talofibular, and tibiofibular syndesmotomic ligaments
- C. Calcaneofibular, tibiofibular syndesmotomic, and deltoid ligaments
- D. Posterior talofibular, anterior talofibular, and calcaneofibular ligaments
- E. Posterior talofibular, calcaneofibular, and deltoid ligaments

**Answer: A.** Usually, the anterior talofibular ligament is injured first, followed by the calcaneofibular ligament if the deforming forces are sufficiently great. In addition, the lateral talocalcaneal ligament may be stressed with an inversion injury, leading to avulsion fractures at either of its attachment sites. Isolated calcaneofibular or posterior talofibular ligament injuries are rare.

- 51.5. A 20-year-old man presents complaining of foot pain after a motor vehicle collision. Radiographs show a fracture of the base of the second metatarsal. What is the most appropriate next step in the patient's management?
- A. Apply a hard-soled shoe.
  - B. Buddy tape second toe and arrange primary care follow-up.
  - C. Discharge on crutches with progressive weightbearing.
  - D. Obtain stress radiographs.
  - E. Splinting and orthopedic referral should be instituted if not the foot is improved in 2 weeks.

**Answer: D.** Findings suggestive of a Lisfranc injury include widening between the first and second or second and third metatarsal bases or any fracture around the Lisfranc joint. A fracture of the second metatarsal base is virtually pathognomonic of occult tarsometatarsal joint disruption. Significant Lisfranc injuries are usually treated with closed reduction and internal fixation with percutaneous Kirschner wires. This is followed by a non-weight-bearing cast for 12 weeks and an orthotic for 1 year. Treatment of a Lisfranc sprain usually involves immobilization for 6 weeks in a below-knee walking cast.

- 51.6. Pain on the medial aspect of the heel that is worse in the morning is suspicious for which of the following disorders?
- A. Compartment syndrome
  - B. Foot sprain
  - C. Osteoarthritis of the ankle
  - D. Plantar fasciitis
  - E. Septic arthritis

**Answer: D.** Plantar fasciitis, an overuse injury of insidious onset, usually begins with pain on first weightbearing in the morning or after prolonged sitting. This progresses to persistent pain during gait. Pain and tenderness are localized to the medial aspect of the heel.

- 51.7. A 28-year-old man was working on a roof when he slipped and fell to the ground feet first. He presents with his right leg shortened and significant ankle swelling. Ankle radiographs show a comminuted distal tibial metaphysis fracture. Which of the following statements regarding this injury is false?
- A. Arthrodesis may be required.
  - B. It has a high association with concomitant injuries.
  - C. It has a low rate of complications.
  - D. Orthopedic consultation for open reduction and internal fixation (ORIF) is necessary.
  - E. Shear forces increase fracture comminution.

**Answer: C.** The primary deforming force of a pilon fracture is one of axial compression, and the position of the foot at the time of injury determines the fracture location and pattern. Shear forces may cause increased comminution and fragment displacement with more extensive soft tissue injuries. Complications are common with pilon fractures, particularly in more severe injuries. Some patients with pilon fractures ultimately require arthrodesis.

## KEY CONCEPTS

- Risk factors for wound infection include crush mechanism; long (>5 cm) deep penetrating wounds; high-velocity missiles; diabetes; and contamination with saliva, feces, soil, or other foreign matter.
- The most effective intervention to decrease infection is thorough cleansing, with use of saline or tap water irrigation at approximately 8 psi. Attaching an 18-gauge needle to a 35-mL syringe creates an irrigant force of 7 or 8 psi, which decreases bacterial counts.
- Soaking wounds in povidone-iodine (Betadine) is more toxic than beneficial to healthy tissue. Prepare the skin with a chlorhexidine-alcohol solution.
- Antibiotics are indicated for through-and-through intraoral lacerations, cat bites, some dog bites, some human bites, puncture injuries to the foot in high-risk individuals, open fractures, and wounds involving exposed tendons or joints.
- High-risk wounds should not be sutured primarily but may be repaired in 4 or 5 days (ie, delayed primary closure).
- Tetanus immunization should be provided soon after injury but can be given days or weeks later. The usual incubation period for tetanus is 7 to 21 days (range, 3 to 56 days).
- Tdap is recommended for patients 65 years old or older requiring tetanus prophylaxis.

## CHAPTER 52: QUESTIONS &amp; ANSWERS

- 52.1. Which of the following is associated with an increased risk of infection?
- A. Avoidance of epinephrine use in wound anesthesia
  - B. High-pressure irrigation
  - C. Use of clippers instead of razors for hair management near wound
  - D. Use of silk suture material
  - E. Use of tape over sutures for wound closure

**Answer: D.** Silk yields the highest infection rates, whereas mono filament synthetic substances have the lowest risk of infection.

## Risk Factors for Wound Infection

1. Injury more than 8-12 hours old (varies depending on the following factors)
2. Location: leg and thigh, then arms, then feet, then chest, then back, then face, then scalp
3. Contamination with devitalized tissue, foreign matter, saliva, or stool
4. Blunt (crush) mechanism
5. Presence of subcutaneous sutures
6. Type of repair: risk greatest with sutures > staples > tape
7. Anesthesia with epinephrine
8. High-velocity missile injuries

- 52.2. A 32-year-old man presents with 20 stab wounds to his arms and legs after sustaining an assault. He weighs 80 kg. Which of the following is an appropriate dosage of wound anesthesia?
- A. 240 mg of 1% lidocaine
  - B. 320 mg of 0.5% bupivacaine
  - C. 400 mg of 0.5% bupivacaine with epinephrine
  - D. 700 mg of 1% lidocaine with epinephrine

**Answer: A.** In adults, the maximal reported safe dose of bupivacaine is approximately 2.5 mg/kg without epinephrine and 3.5 mg/kg with epinephrine, assuming the injection is a wound infiltration technique and not one in a highly vascular area. General dose guidelines for lidocaine are 3 and 5 mg/kg without and 5 to 7 mg/kg with epinephrine, respectively. A 1% lidocaine solution contains 10 mg/mL. The actual percent solution does not matter; the total milligram dose does.

- 52.3. A 23-year-old female presents with a laceration to her thigh. As you begin to apply anesthetic, she tells you that when she went to the dentist she had an allergic reaction to procaine. Which of the following should you use?
- A. Benzocaine
  - B. Benzocaine with epinephrine
  - C. Bupivacaine
  - D. Lidocaine from a multidose vial
  - E. Tetracaine

**Answer: C.** Allergy to local anesthetics is uncommon. Two distinct groups of “caine” anesthetics exist. The esters include procaine, tetracaine, and benzocaine. The second group, including lidocaine and bupivacaine, belongs to the amide family. Allergy to the esters is uncommon. True allergy to agents in the amide family is rare. No cross-reactivity occurs between the amide and ester families, so an agent from a different group may be chosen. A “preservative-free” preparation should ideally be used because the para-aminobenzoic acid in multidose vials may cause an amine-like reaction that may be confused with an allergy to the primary agent.

- 52.4. Which of the following is most likely to require no antibiotic prophylaxis?
- A. Cat bite
  - B. Diabetic with contaminated wound
  - C. Dog bite
  - D. Human bite
  - E. Puncture wound through rubber sole

**Answer: C.** Antibiotic prophylaxis is often provided for patients with wounds with gross contamination, patients with severe crush injuries, and immunocompromised patients. Prophylaxis is also required for patients with cat bites. Seven of eight randomized trials of dog bite wounds showed no benefit with antibiotics. Human bites or lacerations to the metacarpophalangeal (MCP) joint are termed “fight bites,” and these wounds have a high incidence of infection. Thus, of the choices given, dog bites have the lowest incidence of infection and therefore are the least likely to require prophylactic antibiotics.

52.5. Antibiotic coverage of a cat bite must target which of the following pathogens?

- A. *Bacteroides* species
- B. *Clostridium perfringens*
- C. *Eikenella corrodens*
- D. *Pasteurella multocida*
- E. *Pseudomonas* species

**Answer: D.** The organisms found in cat bites include *Staphylococcus* species, *Streptococcus* species, and, most often, *P. multocida*. *P. multocida* is usually found in infected cat bite wounds and is present in the normal oral flora of 70% of all cats. *P. multocida* is sensitive to penicillin, but the infection is often polymicrobial. *P. multocida* is resistant to dicloxacillin, cephalexin, and clindamycin, and there are many erythromycin-resistant strains. Amoxicillin with clavulanate is the current recommendation for antibiotic prophylaxis for cat bites.

52.6. A 74-year-old patient presents with a gaping wound from a dog bite, complaining of pain at the site. The dog belongs to a friend, has reportedly had “all his shots,” and is in custody. The patient is from Central America but has lived in the United States for more than 50 years; he does

not recall his immunization history. Besides copious irrigation and wound dressing, which of the following should be included in the treatment of this patient?

- A. Diphtheria, pertussis, tetanus toxoids (DTaP) and tetanus immunoglobulin (TIG)
- B. Rabies immunization
- C. Tetanus toxoid
- D. Tetanus toxoid and immunoglobulin
- E. B and D

**Answer: A.** Studies show that many people are inadequately immunized, especially patients older than 70 years old, immigrants, and people with no education beyond grade school. Patient immunization histories are often unreliable. Given the inability to predict which wounds are high risk, all wounds should be approached with suspicion. Inadequately immunized patients need a dose of DTaP and TIG. Because studies suggest that 10% to 40% of the population in the United States is inadequately immunized against diphtheria, diphtheria vaccination should be given along with tetanus toxoid. Many adults are not immunized against pertussis, and the incidence of disease has been rising since the 1980s. In 2005, a new acellular form of the pertussis vaccine became available and is recommended for all adults.



## KEY CONCEPTS

- If the history and mechanism of injury are compatible with ocular penetration or if a small puncture wound of the globe is noted, anteroposterior and lateral radiographs of the orbit are an appropriate initial step when the foreign body is thought to be radiopaque. CT and ultrasound are complementary diagnostic studies.
- Although most otic and nasal foreign bodies are amenable to ED removal, instrumentation of these anatomical areas must be effected with great care because removal attempts can cause more injury than the foreign body itself.
- Most airway foreign bodies are seen in pediatric patients and may not be visible on plain films. A normal radiograph does not rule out an aspirated foreign body.
- The patient with critical airway obstruction and impending or actual respiratory arrest requires one of three options: (1) forced expulsion of the foreign body; (2) direct laryngoscopy with attempted manual removal with Magill forceps; or (3) cricothyroidotomy, other transtracheal ventilation, or intubation, while pushing the foreign body distally.
- Esophageal foreign bodies typically are found at one of the three constriction locations: (1) proximal esophagus at the level of the cricopharyngeal muscle and thoracic inlet—radiographically, the clavicular level; (2) midesophagus at the level of the aortic arch and carina; and (3) distal esophagus just proximal to the esophageal-gastric junction—radiographically, a level two to four vertebral bodies cephalad to the gastric bubble.
- Esophageal foreign bodies (eg, coins) usually are oriented in the coronal plane, and airway objects usually are oriented in the sagittal plane.
- Foreign bodies in the stomach and bowel are increasingly managed with a conservative approach with watchful waiting and tracking of the object's progression through the gastrointestinal tract.
- In the perineal region, foreign body removal tends to be more difficult than anticipated by physicians and physically and psychologically traumatic for patients. Consultation with appropriate specialists (eg, urology or general surgery) is indicated.
- The most important determinant of successful soft tissue foreign body removal is an understanding of the object's precise location.

## CHAPTER 53: QUESTIONS &amp; ANSWERS

- 53.1.** A 33-year-old construction worker presents with left eye pain. On gross inspection, you note a watery discharge and moderate erythema. The patient tells you she was working with her coworker when she felt something hit her eye. She admits to not wearing protective goggles. Fluorescein examination of the eye reveals rivulets of dye tracking from a corneal defect. What is the next appropriate step in the patient's management?
- Attempt ultrasound to find a foreign body
  - Check intraocular pressures
  - Obtain orbital computed tomography (CT) scan and consult ophthalmology
  - Obtain plain radiographs of the orbits
  - Topical antibiotics and ophthalmology follow-up in 24 hours

**Answer: C.** Rivulets of fluorescein tracking from the puncture (ie, positive Seidel test) are helpful in identifying the fact that intraocular penetration has occurred. Ultrasound is, as always, operator dependent, and the pressure of the probe on the orbit may risk further injury to an open globe. Checking for intraocular pressures with an open globe is contraindicated. Compared with plain radiographs, CT delivers less radiation to the lens. Multiplanar reconstruction minimizes streak artifacts, affording better localization of intraorbital objects.

- 53.2.** A 2-year-old presents with purulent drainage from the right naris, brought to the ED by a parent concerned about sinusitis. The patient's vital signs are heart rate 110 beats/min, respiratory rate 15 breaths/min, and temperature 37.7°C. On physical examination, you see a small plastic ball in the naris surrounded by swelling and purulent discharge. What should be the next step?
- Attempt to displace the foreign body posteriorly
  - Blow air into the contralateral naris to help dislodge the foreign body
  - Consult the otolaryngologist for removal under anesthesia
  - Make sure you have a right-angle probe, suction, and alligator forceps
  - Treatment with topical vasodilators to facilitate removal

**Answer: D.** The emergency clinician can remove most nasal foreign bodies. Posterior movement of a nasal foreign body risks aspiration; objects should be removed anteriorly via suction or traction. In some circumstances, it may be prudent to place patients in lateral decubitus, perhaps with additional Trendelenburg positioning, to help prevent aspiration of objects. Foreign bodies can sometimes be easily removed via positive pressure applied to the patient's mouth (not the contralateral naris, which should instead be clamped closed to increase pressure on the involved-side naris). Pretreatment with vasoconstrictive spray may improve chances of success. If positive-pressure techniques are not indicated or do not work, it is important to have necessary instruments close at hand to proceed with foreign body removal attempts. These instruments include a blunt-tipped right-angle probe (to maneuver posterior to the foreign body), suction equipment, and alligator forceps.

- 53.3.** A 14-month-old girl presents in respiratory distress after eating a hot dog for lunch. Her mother states that she had stepped out of the kitchen, and when she came back, her daughter was sitting forward with noisy breathing and obvious distress. Which of the following management interventions is contraindicated?
- Back blows
  - Blind finger sweep as the first step
  - Chest thrusts
  - Direct laryngoscopic visualization
  - Intubate for respiratory distress

**Answer: B.** Blind finger sweeping has resulted in conversion of partial to complete airway obstruction when objects are displaced into the subglottic space. For this reason, the technique has lost favor as an initial maneuver in pediatric and adult patients. It is recommended that up to five back blows be delivered (with the patient in a head-down position), followed by chest thrusts. Intubation or needle cricothyroidotomy may be performed if other maneuvers fail and circumstances dictate their need.

- 53.4.** A 45-year-old man was at dinner when he had a choking episode. When he recovered, he experienced new-onset wheezing and presents with the following vital signs: blood pressure 140/90 mm Hg, heart rate 110 beats/min, respiratory rate 20 breaths/min, and arterial oxygen saturation (Sao<sub>2</sub>) 92%. On chest radiograph, you see a flat, fixed diaphragm on the right with a mediastinal shift to the left and inadequate left-sided expansion. What is the next step in the management of this patient?
- A. Albuterol nebulizers and steroids intravenously
  - B. Consult pulmonary for bronchoscopy
  - C. CT scan of the chest with intravenous contrast
  - D. Needle decompression of the left side
  - E. Needle decompression of the right side

**Answer: B.** Air trapping and atelectasis are the most common early clues to airway foreign body presence, with bronchiectasis and bronchial stenosis developing later. In air trapping, a comparison of inspiratory and expiratory films shows a flat, fixed diaphragm on the involved side, and the heart and mediastinum shift to the uninvolved side during expiration. When the foreign object is distal to the oropharynx, however, subspecialty consultation is the safest and most expeditious means for foreign body removal. As a general rule, early bronchoscopy in any patient with a suspected foreign body is key to reducing morbidity and mortality.

- 53.5.** A concerned father brings in his toddler, who has swallowed a button battery. Which of the following management strategies is most appropriate for this patient?
- A. Endoscopy is indicated if it is above the lower esophageal sphincter.
  - B. Endoscopy is not indicated if it is found in the esophagus.
  - C. Expectant management is appropriate.
  - D. If it is in the small bowel, further surveillance is not indicated.
  - E. Nifedipine may aid in the movement of the battery through the esophagus.

**Answer: A.** If a disk battery has been ingested, its location must be ascertained with immediate removal if it has lodged in the esophagus. If the button battery has passed distal to the esophagus, the patient can be observed, with follow-up radiography to confirm spontaneous passage through the gastrointestinal tract. Nifedipine is occasionally effective in managing food boluses but should not be used to manage nonorganic foreign bodies.

- 53.6.** Which of the following is an initial management option for esophageal food bolus impactions in the ED?
- A. Glucagon
  - B. Nifedipine
  - C. Papain
  - D. Sublingual nitroglycerine

**Answer: A.** Two agents used for distal food bolus impaction, which are probably not as useful as glucagon, are nitroglycerine and nifedipine. A last approach, enzymatic degradation of an impacted meat bolus using the proteolytic enzyme papain, has fallen into disfavor because of risks of esophageal perforation. The gold standard intervention strategy for esophageal foreign body removal is endoscopy.

- 53.7.** What do you expect to see on the chest radiograph of a child who has swallowed a coin?
- A. Foreign body anterior to tracheal air column
  - B. Foreign body causing air trapping on the left side
  - C. Visualized flat foreign body in the coronal plane
  - D. Visualized round foreign body in the coronal plane
  - E. Visualized round foreign body in the transverse plane

**Answer: D.** Esophageal foreign objects usually align themselves in the coronal plane and are posterior to the tracheal air column on lateral view. Coins in the esophagus lie in the coronal position in virtually all cases because the opening into the esophagus is much wider in this orientation.

## KEY CONCEPTS

- Mammalian bites require evaluation not only as traumatic injuries but also for their risk of infection.
- Cat and human bites are at higher risk for infection than dog bites.
- Most mammalian bite wound infections are polymicrobial. *Pasteurella* species are the most common pathogens in dog and cat bites.
- The value of prophylactic antibiotics for mammalian bites is secondary to the value of proper cleaning, débridement, and irrigation of the wounds.
- Prophylactic antibiotics should ideally be given within 3 hours of the bite and continued for 5 days.
- Amoxicillin-clavulanate (Augmentin) is the prophylactic antibiotic of choice for dog, cat, and human bites. Moxifloxacin is an alternative for those patients that are penicillin-allergic.
- The decision to close mammalian bite wounds must weigh the benefit of improved cosmesis against the increased risk of wound infection.
- Given their propensity for infection, mammalian bites to the hand should not be closed primarily. Most facial bites can safely be closed if done so within 24 hours of the bite.
- Due to the anatomy of the hand, clenched fist injuries (CFIs) or “fight bites” have exceptionally high rates of damage to deep structures and infection.
- Mammalian bites to the hand should receive prophylactic antibiotics. Any infected human bite to the hand should be treated on an inpatient basis.

## CHAPTER 54: QUESTIONS &amp; ANSWERS

- 54.1. A 75-year-old woman presents with a puncture mark on her hand. She reports being bitten by her cat the previous night. Which of the following statements regarding this patient's injury is *true*?
- Capnocytophaga canimorsus* is the organism of concern.
  - Cats are very clean animals and do not carry any virulent strains.
  - Cats produce superficial infections because their teeth are not long enough to inoculate past the dermis.
  - Concern exists for a virulent gram-negative bacterium, which can produce a rapid cellulitis.
  - Irrigation and topical antibiotics are indicated.

**Answer: D.** Cats have long, slender, pointed teeth that can penetrate tendons, joints, and bone, inoculating bacteria deep into these tissues. Cat bites have a substantially higher risk of infection than dog bites do. Another important factor in the development of wound infection after cat bites involves the presence of *Pasteurella multocida*, a highly virulent, gram-negative, facultatively anaerobic rod found in the oral cavity or nasopharynx of 70% to 90% of healthy cats.

- 54.2. What is the most appropriate antibiotic prophylaxis for a cat bite?
- Amoxicillin-clavulanate
  - Clindamycin
  - Erythromycin
  - First-generation cephalosporins
  - Vancomycin

**Answer: A.** In vitro, *P. multocida* is sensitive to penicillin, ampicillin, tetracycline, fluoroquinolones, amoxicillin-clavulanate, second- and third-generation cephalosporins, and trimethoprim-sulfamethoxazole.

- 54.3. A 19-year-old man presents 10 hours after sustaining a dog attack. He has multiple lacerations on his head and right hand. What is the appropriate management of this patient?
- Repair the hand and the head lacerations
  - Repair the hand laceration but not the head laceration
  - Repair the head laceration but not the hand laceration
  - Use Steri-Strips on all and give him a prescription for amoxicillin-clavulanate (Augmentin)
  - Wound cleansing and bandaging

**Answer: C.** For dog bites, the infection rate of hand wounds is as high as 30%, regardless of suturing, whereas the infection rate of dog bites elsewhere averages 9%. Similarly, dog bites of the face and neck (including punctures) have an infection rate of only 0% to 5% even when they are sutured. Bite wounds of the face and scalp from any species that are less than 12 hours old may be cleansed well and sutured. Most other bite wounds that are going to be closed should have this done within 6 hours.

- 54.4. Selected monkey bites require postexposure prophylaxis with which of the following medications?
- Amoxicillin clavulanate
  - Clindamycin
  - Flagyl
  - Tetracycline
  - Valacyclovir

**Answer: E.** Valacyclovir to prevent herpes B virus infection. Other terms for this virus include *herpesvirus simiae*, *herpesvirus B*, and *monkey B virus*. This virus has serologic cross-reactivity with herpes simplex virus (HSV) type 1 and type 2, which cause herpetic lesions in humans. Seventy-three percent to 100% of monkeys of the genus *Macaca* (macaques) used for biomedical research are seropositive for the B virus. Other antibacterials may be needed if cellulitis infection ensues.

## KEY CONCEPTS

- Snake venom causes neurotoxicity and hematotoxicity, but one usually predominates, depending on the species of snake.
- The amount of crotalid antivenom given depends on the grade of envenomation, from 0 (minimal or no sign of envenomation) to IV (severe envenomation). Antivenom recommended for grade II to IV snakebites. Children require the same amount of antivenom as adults.
- Pit vipers have a characteristic pit found midway between the eye and the nostril on both sides of the head.
- Arthropods such as hymenoptera account for more deaths from envenomation than snakes, usually as a result of allergic reactions.
- Black widow spider bites are neurotoxic causing severe pain and muscle spasms; brown recluse spider bites cause necrotizing skin wounds.
- Nematocyst (jellyfish) stings should be immediately neutralized with vinegar or hot water, and fish stings with hot water. Stings from venomous fish (such as, lionfish and sting rays) are treated with circulating hot water to denature the toxin.

## CHAPTER 55: QUESTIONS &amp; ANSWERS

- 55.1. Which of the following venomous snakes in the United States is a member of the neurotoxic Elapidae family?
- Copperhead
  - Coral snake
  - Rattlesnake
  - Water moccasin

**Answer: B.** Pit vipers from the family Viperidae are the most prevalent venomous snakes in the United States. They are native to every state except Maine, Alaska, and Hawaii. They are classified into three main groups: true rattlesnakes (genus *Crotalus*), copperheads and water moccasins (genus *Agkistrodon*), and pygmy and Massasauga rattlesnakes (genus *Sistrurus*). Pit vipers account for 98% of all venomous snakebites in the United States. Other families include Colubridae, Hydrophiidae, Elapidae (to which the neurotoxic coral snake belongs), and Crotalidae.

- 55.2. A 30-year-old man complains of pain, burning, and swelling of his hand after gardening. Physical examination shows two puncture marks on his thenar eminence, as well as moderate localized swelling. When you inquire about it, he said that he did have some burning pain briefly while digging around in the ground by a bush, but he dismissed it as abrasions from sharp sticks. That was 2 hours ago. What should you do next?
- Apply a constricting band to impede venous and arterial flow.
  - Discharge with instructions for rest, ice, immobilization, and use of oral antibiotics.
  - Give tetanus and clindamycin for prophylaxis.
  - Obtain baseline laboratory studies and observe the patient for increasing symptoms.
  - Test compartment pressure and prepare for fasciotomy.

**Answer: D.** The symptoms are typical for a pit viper snakebite. The most consistent symptom associated with pit viper bites is immediate burning pain in the area of the bite, whereas pain may be minimal with bites of Elapidae and other exotic snakes. Tetanus prophylaxis may be indicated, but antibiotics are not. Fasciotomy is rarely if ever indicated for snakebite. A constricting band may be useful for first aid in the field with certain neurotoxic snakes, but not in the emergency department (ED). Immobilization may be helpful, but ice and antibiotics are not.

- 55.3. A 43-year-old woman sustained a snakebite while in her garden. She was not able to secure the snake, but she remembered it to be colorful. She presents with ptosis, slurred speech, and nausea. What is true about the type of snake most likely involved in this case?
- Death usually occurs from coagulopathies.
  - Eastern species are the most deadly.
  - The snake has a heat-sensitive organ between eyes and nostrils on both sides of the head.
  - The snake has a triangle-shaped head.
  - The snake has elliptical pupils.

**Answer: B.** This woman sustained a bite from a coral snake. All of the above except B are related to pit vipers. The coral snake can be differentiated from the king snake by two characteristics: the nose of the coral snake is black, and the red and yellow bands are adjacent on the coral snake. Eastern coral snake is considered deadly as opposed to its western relative. There are no records of fatalities caused by the western species. Ptosis is common and often the first outward sign of envenomation. Other signs and symptoms include vertigo, paresthesias, fasciculations, slurred speech, drowsiness, dysphagia, increased salivation, nausea, and proximal muscle weakness.

- 55.4. Which of the following is true about antivenom?
- Antivenom may reverse all the symptoms of envenomation.
  - Antivenom should be administered around the wound.
  - Even mild envenomations require antivenom.
  - Exotic snakebites require only antivenom if neurologic symptoms are present.
  - Pregnancy is a contraindication to receive antivenom.

**Answer: A.** Pregnancy is not a contraindication to antivenom therapy. Any victim of a venomous snakebite with moderate or severe envenomation is a candidate for antivenom. Antivenom may reverse the local signs, systemic symptoms, and laboratory abnormalities associated with envenomation. As with coral snakes, many patients do not show any early signs after envenomation by exotic snakes. The antivenom should be administered before neurologic changes develop. All antivenom should be administered intravenously.

- 55.5. A 28-year-old man presents with a copperhead snakebite that occurred 1 hour ago. He complains of pain and moderate swelling of his right hand and wrist. He has no systemic symptoms and has a pulse of 92. His initial coagulation studies are normal. What should be done?
- Admit for observation and antivenom
  - Discharge with elevation, ice, and pain medications
  - Give antivenom if swelling spreads to forearm
  - Immediate antivenom 4 vials intravenously
  - Observe 12 hours for signs of increasing envenomation

**Answer: E.** Most copperhead bites do not require antivenom. Some toxicologists will administer antivenom if swelling is severe and may cause long-term disability. Copperhead bites generally cause a moderate amount of swelling that may peak 24 to 36 hours after the bite. All venomous snakebites should be observed for at least 12 hours if signs of envenomation are present. If systemic signs develop or the patient develops a coagulopathy, antivenom may be indicated.

- 55.6. Which of the following patients is most likely to be the first discharged home safely?
- A. A pregnant woman with black widow envenomation
  - B. A 5-year-old child with a scorpion sting 1 hour before arrival
  - C. A 55-year-old man with hypertension and coronary artery disease with black widow envenomation
  - D. An 8-year-old with a coral snake bite
  - E. An 18-year-old with an unknown snake bite 8 hours before arrival

**Answer: E.** A scorpion sting in a child should be observed for at least 6 hours. Symptomatic children with stings should be admitted. Most venomous snakes will show signs of envenomation within 6 hours. If this patient is asymptomatic, it is likely that the snake was nonvenomous or this was a “dry bite.” All children with envenomation and coral snake bites should be admitted for observation. Pregnant patients and those with coexisting medical problems should be admitted after black widow envenomations.

- 55.7. While walking in shallow water, a patient accidentally steps on a stonefish. Which of the following is not indicated?
- A. Irrigating the wound with vinegar
  - B. Obtaining radiographs for retained foreign body
  - C. Observing for cardiovascular and respiratory symptoms
  - D. Removing the spine with forceps
  - E. Using hot water to relieve the pain

**Answer: A.** Stonefish, a type of bony fish, may cause serious cardiac and respiratory symptoms, which can be prevented by early administration of the appropriate antivenom. The fish spines of bony fish should be removed with forceps because they are thick and less likely to break off at the skin (like a bee stinger). In all cases, the wound should be copiously irrigated. Vinegar has been shown to be useful for some types of nematocyst injuries from jellyfish. Significant analgesia is achieved by submersion of the wound in hot water for 30 to 90 minutes or until improvement.

- 55.8. A patient presents with a necrotic lesion on her mid thigh that started as a bleb while she was working in her garden 3 days ago. The wound has grown gravitationally. Her blood pressure is 110/80 mm Hg, respiratory rate 16 rpm, heart rate 110 bpm, and temperature 38.3°C. You suspect an envenomation of which of the following?
- A. *Centruroides exilicauda*
  - B. *Haplochroma maculosa*
  - C. *Haplochroma lividum*
  - D. *Latrodectus mactans*
  - E. *Loxosceles reclusa*

**Answer: E.** The cobalt blue tarantula, *Haplochroma lividum*, is an aggressive spider with toxic venom. The black widow spider is *Latrodectus mactans*. *Centruroides exilicauda*, which is found in Arizona, is a particularly dangerous kind of scorpion. The blue-ringed octopus is *Haplochroma maculosa*. The brown recluse spider, *Loxosceles reclusa*, causes an initial white area of vasoconstriction at the site of the bite within 3 or 4 hours. A bleb then forms in the center of this area, and an erythematous ring arises on the periphery. The lesion at this stage resembles a bull's-eye. The bleb darkens, necroses during the next several hours to days, and continues to spread slowly and gravitationally.



## KEY CONCEPTS

- After carefully removing the patient from the source of injury, burns should be cooled with room temperature water while avoiding hypothermia in patients with very large burns.
- Clinical signs such as facial burns, hoarseness, drooling, carbonaceous sputum, and singed nasal hairs certainly should raise the probability of inhalation injury; however, they are often unreliable and poor predictors of injury severity.
- The best way to confirm inhalation injury and the need for endotracheal intubation is by directly visualizing the upper airways with fiberoptic, video or direct laryngoscopy using topical anesthesia supplanted with mild to moderate sedation when necessary. The presence of significant edema or soot in the supraglottic region necessitates immediate intubation.
- Supplemental oxygen should be given in patients with suspected inhalation injury and determination of carbon monoxide levels should be performed.
- Fluid management to support vital organ perfusion and adequate urine output using crystalloids by the Parkland formula or modified Brooke formula should be administered as recommended by the American Burn Association.
- Adequate pain relief for larger burns may be accomplished using frequent intravenous titration with opioids supplemented with sub-dissociative doses of ketamine.
- While patients with large (>20% for adults and >10% for children and the elderly) or deep burns will require admission to a burn center, most patients presenting to the ED will have small and superficial burns that can be managed by over-the-counter topical antibiotic ointments (silver sulfadiazine is no longer recommended except for highly contaminated or infected wounds), or with one of many commercially available burn dressings.

## CHAPTER 56: QUESTIONS &amp; ANSWERS

**56.1.** A 30-year-old man presents with a burn to both anterior aspects of his forearms after being burned by a radiator. He has severe pain and has deep (reticular) dermis extension of the burn. You call the consultant and describe the burn as which of the following?

- A. First-degree burn of 4.5% body surface area
- B. Second-degree superficial burn of 9% body surface area
- C. Second-degree deep burn of 4.5% body surface area
- D. Third-degree burn of 2.5% body surface area
- E. Fourth-degree burn of 9% body surface area

**Answer: C.** Deep second-degree burns extend through the epidermis into the deep (reticular) dermis. Body surface area is determined by the rule of nines. Nine percent for each upper extremity means that the forearm is approximately one fourth of 9%. Two forearms burns are half of 9%. Second-degree burns are often more painful than third-degree burns, in which all of the nerve endings are destroyed.

**56.2.** A 3-year-old boy presents with circumferential burns involving both upper extremities, including his hands, from pulling a boiling pot of water off the stove. The burns are mixed second-degree and third-degree burns. Which of the following best describes the body surface area burned and the most appropriate disposition?

- A. 9% and admit to pediatrics with surgery consultation
- B. 9% and transfer to burn unit
- C. 18% and transfer to burn unit
- D. 18% and admit to pediatric surgery
- E. 20% and admit to pediatric intensive care unit

**Answer: C.** Children with burns over 10% total body surface area (TBSA) should be transferred to a burn unit. In addition, hand burns should be treated at a burn unit. Circumferential burns are not consistent with a splash injury, and child abuse should be suspected and reported.

**56.3.** A 55-year-old, 80-kg man presents with second-degree burns of both his legs, front torso, and groin. What is the initial fluid resuscitation according to the Parkland formula?

- A. 500 mL lactated Ringer solution in the first 4 hours
- B. 1100mL normal saline in the first hour
- C. 1100mL of lactated Ringer solution in the first hour
- D. 2400 mL normal saline in the first hour
- E. 4200mL lactated Ringer solution in the first 4 hours

**Answer: C.** The amount of lactated Ringer solution required for the first hour can be rapidly estimated with the Parkland formula by multiplying the estimated total body surface area (TBSA) of the second- and third-degree burn (55%) by body weight in kilograms (80 kg) and dividing by 4.

**56.4.** A 25-year-old woman presents with a second-degree burn to her right forearm after a grilling accident. You note

areas of gray discoloration with decreased blanching in the erythematous region of the burn. In addition to irrigation, débridement, and dressing with a nonadherent dressing, which of the following would be the most appropriate treatment?

- A. Apply silver sulfadiazine and follow-up with plastic surgery in 1 week
- B. Calculate the Parkland formula and administer fluids before discharge
- C. Educate the patient about daily dressing changes and have her follow-up with plastic surgery in 24 to 48 hours
- D. Immerse her forearm in ice water for pain control
- E. Unroof soft blisters and have the patient follow-up with her primary care physician in 1 week

**Answer: C.** The distinction between superficial and deep second-degree burns is important in that deep second-degree burns often do not heal within 2 or 3 weeks and may result in severe scarring and contractures, especially in children. As a result, deep second-degree burns that do not heal within 21 days may require excision and skin grafting to minimize scarring. Deep second-degree burns may also progress to third-degree burns during the course of several days after injury. Burns over less than 20% TBSA can be treated with oral hydration. Blisters are generally left intact initially if possible. They may later require débridement.

**56.5.** Which of the following is an indication for intubating a patient who was found in a burning house?

- A. Facial edema
- B. Fire occurred in a closed space
- C. Patient unable to handle own secretions
- D. Singed eyebrows
- E. Soot in the airway and singed nasal hair

**Answer: C.** See [Box 56.1](#). Traditionally, inhalation injury was diagnosed on the basis of clinical findings, such as facial burns, singed nasal vibrissae, carbonaceous sputum, and a history of injury within a closed space. However, these findings are neither highly sensitive nor highly specific. Nonetheless, these patients must be closely observed for potential delayed airway compromise.

**56.6.** What is the most appropriate management for a superficial partial thickness burn on the forearm?

- A. A clean dry dressing, such as gauze
- B. A commercially available silver containing dressing
- C. Systemic antibiotics and silver sulfadiazine
- D. Topical antibiotic ointment
- E. B and D

**Answer: E.** Superficial partial thickness burns may be treated with a topical antibiotic ointment or one of several commercially available silver releasing dressings. Silver sulfadiazine, as well as dry dressings, will slow reepithelialization. Silver sulfadiazine is appropriate for infected or heavily contaminated burns. Systemic antibiotics are *not* indicated for non-infected burns.

## KEY CONCEPTS

- For chemical injury, the degree of skin destruction is determined mainly by the properties of the toxic agent, its concentration, and the duration of its contact.
- Chemical injuries are commonly encountered after exposures to acids and alkalis.
- HazMats are substances that can cause physical injury and can damage the environment if improperly handled.
- In dealing with HazMat incidents, two distinct goals must be achieved: (1) The HazMat must be contained, fire and explosions should eventually be extinguished, and the site must eventually be cleaned, and (2) people exposed to the HazMat must be decontaminated and treated.
- Decontamination consists of removal of contaminated clothing and hydrotherapy (ie, wash the skin) for the majority of exposures. For lithium, potassium, and sodium exposure, hydrotherapy is contraindicated because of the exothermic reaction with contact with water.
- Alkali burns tend to penetrate deeper than acidic burns; as a result, alkali burns tend to be associated with greater morbidity.
- Hydrofluoric acid burns can be associated with significant hypocalcemia.
- Exposure to various toxic gases can occur from routine industrial settings, and knowledge of these agents is necessary for proper treatment by the emergency clinician.
- Unconventional chemical weapons may be categorized into four major classifications: nerve agents, vesicants, choking agents, and cyanide agents.

## CHAPTER 57: QUESTIONS &amp; ANSWERS

57.1. A 34-year-old man presents with burning, erythema, and blurred vision after cleaning liquid is splashed in his eye. Which of the following should you do?

- A. Be concerned about acidic burn.
- B. Be concerned about alkali burn.
- C. Postpone irrigation until confirmation of the type of cleaning liquid.
- D. Use a miotic agent.
- E. Use copious irrigation until a pH of 7.4.

**Answer: E.** When a chemical injury to the eye is suspected, regardless of the offending agent, copious irrigation should be started immediately. Irrigation with water or normal saline should continue until the pH is at a physiologic level (approximate pH of 7.4). All but the mildest burns should be treated with a long-acting cycloplegic, a mydriatic.

57.2. A patient presents to the emergency department (ED) complaining of severe burning of both hands since leaving her building this morning. In her history, you find out that the metal doors of her housing complex had just been cleaned of all rust. She has small blisters on her palms and a white appearance to the skin. What is the next step?

- A. Consult plastics for an alkali burn.
- B. Leave blisters, cover with bacitracin and gauze.
- C. Mix calcium gluconate with KY jelly, apply to hands and cover with gloves.
- D. Obtain pain control and prescribe oral clindamycin.
- E. Treat as a second-degree burn.

**Answer: C.** The rust cleaning and physical findings are descriptive of a hydrofluoric acid burn. It is also commonly used in the production of microelectronics, etching glass, for removing rust, and for cleaning cement and bricks. Calcium gluconate (2.5%) gel is the preferred topical agent. However, this gel is often not available in hospital pharmacies, but it can be made by mixing 3.5 g calcium gluconate powder in 150 mL of a water-soluble lubricant. The gel should be secured by an occlusive cover, such as a latex glove.

57.3. In a hydrofluoric burn, what electrolyte abnormality causes systemic manifestations contributing to this chemical's significant morbidity and mortality?

- A. Hypercalcemia
- B. Hypermagnesemia
- C. Hypocalcemia
- D. Hypokalemia
- E. Hyponatremia

**Answer: C.** Hydrofluoric acid binds calcium and magnesium ions with strong affinity. Systemic manifestations of fluoride toxicity are at least partly related to hypocalcemia and include abdominal pain, muscle fasciculations, nausea, seizures, ventricular dysrhythmias, and cardiovascular collapse. Of note, hyperkalemia is often a terminal finding in fatal cases.

57.4. A 29-year-old man presents by emergency medical services confused and hypoxic. Vitals signs are blood pressure 100/70 mm Hg, heart rate 120 beats/min, respiratory rate 22 breaths per minute, and an oxygen saturation of 83% despite 100% oxygen via non-rebreathing mask. The arterial blood gas is reported as venous. You see the syringe and note that the color is a chocolate brown. Which of the following should be the next step?

- A. Determine the methemoglobin level and prepare methylene blue
- B. Methylene blue intravenously
- C. Sodium thiosulfate intravenously
- D. Urine assessment for "vin rose" coloration
- E. Wood's lamp to aid in the diagnosis

**Answer: A.** The patient is suffering from methemoglobinemia. For those symptomatic patients without glucose-6-phosphate dehydrogenase (G6PD) deficiency, 2 mL/kg of 1% methylene blue can be administered over 3 to 5 minutes. Symptoms typically improve within 20 minutes. Severe cases can be treated with exchange transfusion. Candidates for exchange transfusion include those with G6PD with significant toxicity from methemoglobinemia or those patients who fail to respond to methylene blue.

**57.5.** A 21-year-old man presents to the emergency department (ED) with chronic shortness of breath and a “huffer’s rash.” The patient has dry, cracked skin with perioral pyoderma. The cause of these symptoms is most likely which of the following?

- A. Anhydrous ammonia
- B. Cyanide
- C. Hydrocarbons
- D. Nitrites
- E. White phosphorous

**Answer: C.** The toxicity from hydrocarbons can affect many different organs, but the lungs are the most commonly affected organ. The toxicity is directly related to the volatility and inversely related to the viscosity and surface tension. Chronic dermal exposure to hydrocarbons can result in perioral or perinasal dermatitis with pyoderma. This so-called “huffer’s rash” is primarily seen with recreational abuse.

**57.6.** Nerve agent poisoning may be rapidly fatal. Beside appropriate decontamination, which of the following should be administered?

- A. British anti-Lewisite 2 mg/kg intramuscularly
- B. Methylene blue 2 mg/kg intravenously
- C. *N*-acetylcysteine 140 mg/kg orally
- D. Pralidoxime 600 mg intramuscularly
- E. Pyridostigmine 1 mg intravenously

**Answer: D.** Nerve agents work by affecting acetylcholine (ACh) levels via inhibition of acetylcholinesterase. ACh receptors are found on the postsynaptic receptor of cholinergic synapses. These receptors can be either nicotinic or muscarinic. The effects at the muscarinic receptors include excess secretions and smooth muscle contractions. The initial recommended treatment is 2 mg of atropine for adults, although much larger doses will likely be required. Pralidoxime should also be administered to patients with suspected or known ingestion with significant symptoms. This agent potentially helps prevent irreversible inhibition of the acetylcholinesterase enzyme.

**57.7.** A 31-year-old man was found in his apartment after an apparent suicide attempt. He smells of bitter almonds. He is obtunded with hypotension, tachypnea, and normal oxygen saturation. After decontamination and resuscitation, what is the next step?

- A. Atropine
- B. Hydroxocobalamin
- C. Methylene blue
- D. Naloxone
- E. Sodium thiosulfate

**Answer: B.** This patient likely has cyanide poisoning. One method of treatment involves the administration of amyl nitrite, sodium nitrite, and sodium thiosulfate. The U.S. Food and Drug Administration (FDA) approved hydroxocobalamin (Cyanokit) for treatment of cyanide intoxication. Hydroxocobalamin binds to cyanide to form cyanocobalamin, which subsequently undergoes renal excretion.

## KEY CONCEPTS

- Sexual assault is more common in women, but can happen in gay and heterosexual men, and in lesbian, gay, bisexual, transgender, and gender-nonconforming individuals.
- Sexual assault often results in no physical signs of injury.
- Optimal care includes creating a safe confidential environment while incorporating the principles of trauma-informed care. The patient should be included in decision making and ultimately decide treatment. Options include injury evaluation, treatment to prevent pregnancy and STIs, support and trauma counseling, evidence collection, and comprehensive toxicology testing if within jurisdictional time limits.
- The sexual assault evidence collection examination is an intensive, protocol-driven, multistep process, best performed by a certified sexual assault examiner.
- Adult sexual assault patients should be treated empirically according to CDC guidelines to prevent STIs (including gonorrhea, syphilis, chlamydia, trichomonas, HIV, and hepatitis B), where appropriate. Children and adolescents should be tested and, if symptoms develop, treated for STIs.
- All adolescent and adult female sexual assault patients should be offered pregnancy prophylaxis.
- HIV postexposure prophylaxis should be offered if the assailant is known to be HIV-positive or if multiple assailants are involved or, if the HIV status of the assailant is unknown, offered on a case by case basis.
- Alcohol and drugs may have been ingested voluntarily or involuntarily by the patient. If the patient consents, comprehensive toxicology testing may be appropriate.
- A strangulation attempt with loss of consciousness, bowel and bladder incontinence, persistent voice changes, difficulty swallowing, or shortness of breath should be comprehensively evaluated in the ED. Evaluation options include a chest x-ray, flexible laryngoscopy, and CTA or MRI of the neck. Admission should be considered for persistent symptoms.
- Many victims will not have obvious physical injuries; this does not imply consent or refute a sexual assault.
- The emergency clinician should not determine if a sexual assault happened but should record observations, statements, and findings objectively that were gathered during the course of ED treatment.

## CHAPTER 58: QUESTIONS &amp; ANSWERS

- 58.1.** Which of the following statements best describes hepatitis B infection prevention for victims of sexual assault?
- Give HBIG and hepatitis B vaccine if the patient has not been immunized.
  - Give HBIG only if the patient has not been immunized.
  - Give hepatitis B vaccination if patient is unimmunized or uncertain.
  - Give hepatitis B vaccine only if serologic testing shows that the patient is not adequately immunized.
  - Serologic testing is always required, followed by hepatitis B immunoglobulin (HBIG).

**Answer: C.** Give hepatitis B vaccination if the patient is unimmunized or uncertain. Follow-up doses should be given at 1 to 2 months and 4 to 6 months (total of three doses). This strategy, which avoids the need for serologic testing, has been shown to be effective. HBIG is not recommended by the CDC after sexual assault (although it is recommended in body fluid exposures in unimmunized health care workers).

- 58.2.** Which of the following empirical antibiotic regimen is indicated for sexual assault patients to prevent sexually transmitted infections?
- Cefixime, 400 mg PO
  - Cefixime, 400 mg PO once, plus doxycycline, 100 mg PO bid for 10 days
  - Ceftriaxone, 1 g IM (intramuscularly)
  - Ceftriaxone, 1 g IM, plus azithromycin, 2 g orally (PO)
  - Ceftriaxone, 250 mg IM, plus metronidazole, 2 g PO, plus azithromycin, 1 g PO

**Answer: E.** Ceftriaxone is given to cover gonorrhea, azithromycin to cover chlamydia, and metronidazole (Flagyl) to cover *Trichomonas*. Ceftriaxone is preferred over oral cefixime to cover incubating syphilis and due to increasing gonorrhea resistance. Many providers opt to give the metronidazole to take at home because it increases the risk of nausea and vomiting, a common side effect of many of the medications (including emergency contraception and HIV postexposure prophylaxis).

- 58.3.** Which of the following statements best describes sexual assault in males?
- Ejaculation should not occur in the victim during male sexual assault.
  - Males are more likely to overreport sexual assault.
  - Males are more likely to require sexually transmitted infection (STI) prophylaxis.
  - Males do not require referral to rape crisis centers.
  - Males may require anoscopy to detect anogenital injuries.

**Answer: E.** Males may actually suffer more anogenital injuries than woman; injury detection can be aided or enhanced by using an anoscope. Males underreport the crime, do not seek medical attention, and absolutely need referral to rape crisis centers for post-rape care and counseling. Males are not more likely to require STI prophylaxis because the risk of transmission per act does not change based on gender. Ejaculation may occur during sexual assault due to prostatic stimulation and fear arousal. This should not be taken to infer that the assault was consensual.

- 58.4.** Sexual assault often leads to injury. Which of the following statements best describes the rate of sexual assault injury in females?
- Genital injury can be seen following consensual and nonconsensual intercourse.
  - Nongenital injury is uncommon and rarely seen.
  - Resistance of the victim and force used do not influence the risk of genital injury.
  - The precise location of genital injury can be used to confirm sexual assault.
  - The presence of genital injury confirms that a sexual assault occurred.

**Answer: A.** Genital injury can be seen following consensual and nonconsensual intercourse; its presence or location of injury does not confirm that a rape occurred. Nonconsensual intercourse (sexual assault) is more likely to result in more injuries that can be more severe. Other bodily injury can be commonly seen and may be more common than genital injury. Injury can be influenced by age, virgin status, resistance, force, number of assailants, and relationship of the assailant to the victim.

**58.5.** Which of the following factors reduces the likelihood of finding genital injury during the sexual assault examination?

- A. Digital penetration
- B. Increased time since sexual assault occurred
- C. Penile penetration
- D. Use of foreign object during the assault
- E. Victim sexual immaturity

**Answer: B.** The genital structures heal quickly, so the longer the time since the sexual assault occurred, the less likelihood of finding evidence of injury on examination. All the other factors increase the likelihood of finding genital injury at the time of the sexual assault examination.

**58.6.** A 25-year-old woman presents 4 days after vaginal penetration. Her body mass index (BMI) is 35. Which of the following is true about emergency contraception (EC)?

- A. A pregnancy test is mandatory prior to offering EC.
- B. She should be offered levonorgestrel because it is more effective in this situation.
- C. She should be offered ulipristal.
- D. She should have an intrauterine device (IUD) inserted because this is the most effective form of EC for her.
- E. She should not receive EC because it will likely be less effective due to her BMI.

**Answer: C.** Emergency contraception should be offered up to 5 days after vaginal assault. Ulipristal, levonorgestrel, and high-dose birth control pills are options. Ulipristal is more effective after 72 hours and in women with a BMI greater than 26. At a BMI above 35, both forms of oral EC are less effective, but should still be administered if there is no alternative. IUD placement is the most effective form of EC; it can be placed up to 5 days after assault. IUD placement allows for ongoing birth control in situations where there is likely to be loss of reproductive control (intimate partner assault), but is often less desirable after assault. IUD placement is most often not available in a timely manner. A pregnancy test is not mandatory prior to giving EC because it will not harm an existing pregnancy. A pregnancy test is suggested prior to ulipristal administration, given the lack of large studies in pregnant women.

**58.7.** A 28-year-old woman presents following sexual assault, during which the assailant strangled her, and she passed out. Which of the following is true concerning this patient's injury?

- A. Nonfatal strangulation has little impact on the risk of future injury in the domestic violence victim.
- B. Regardless of her symptoms, no additional imaging is needed.
- C. The hyoid bone is commonly fractured during an attempted strangulation.
- D. The signs and symptoms of nonfatal strangulation are usually caused by arterial or venous blood flow occlusion or blockage of air entry through the trachea.
- E. There must be physical evidence of injury for it to be a proven case of nonfatal strangulation.

**Answer: D.** Strangulation leads to hypoxia by jugular vein occlusion, carotid artery occlusion, or blockage of the airway. The hyoid bone is rarely injured. A large percentage of patients may have no physical findings and may require imaging, depending on the signs and symptoms present. In intimate partner violence (IPV) relationships, nonfatal strangulation increases the risk of future homicide sevenfold.



## KEY CONCEPTS

- Intimate partner violence encompasses a pattern of controlling behaviors, including intentional physical assault, sexual assault, psychological violence, and financial control.
- Treatment and intervention in intimate partner violence may be compared to a chronic disease model, whereby intervention happens over time, and relapses may be a part of the cycle. It is also critical to remember that although intervention is often offered to the survivor, responsibility for the behavior should be placed on the abusive partner.
- Treatment and intervention in IPV requires a coordinated approach, including physician training, an integrated system that includes social work and IPV counselor availability, and a close relationship with area IPV service provider groups.
- Routine screening for IPV in women of childbearing age is recommended by the USPSTF; screening methods may include paper-based, computer-based, face to face (by nurse or physician), or combination of screening methods.
- Sequelae of IPV include chronic pain, mental health issues (eg, depression, PTSD, substance abuse), STIs and unintended pregnancy, and worsening of medical problems (eg, diabetes, asthma).
- Attempted strangulation in IPV is associated with a sevenfold increased risk of an attempted or completed lethal attack, and patients should be encouraged to seek protection from further incidents.
- Some cases of IPV presenting to the ED may actually be cases of human trafficking. Cases of human trafficking have a very different dynamic and require specialized interventions.

## CHAPTER 59: QUESTIONS &amp; ANSWERS

- 59.1.** By state law, you are a mandated reporter for intimate partner violence (IPV). You are concerned about violating the Health Insurance Portability and Accountability Act (HIPAA). Which of the following is correct?
- Patients are always free to act of their own free will.
  - Reporting should be done without telling the patient, because you cannot report if the patient objects.
  - When reporting is required by law, it does not require patient consent.
  - You need a signed consent to make the report.
  - You should call the legal department before reporting.

**Answer: C.** IPV patients are not always free to act of their own will in health care decision making. Some states have laws that require reporting to local authorities. Reporting of health conditions required by local laws are exempted from HIPAA regulations. Fear may be so profound in the IPV survivor that decision making is impaired, thus jeopardizing informed consent.

- 59.2.** Which of the following is not suspicious for intentional injury from IPV?
- Bilateral injuries
  - Ecchymosis of lower extremity
  - Injuries to the breasts or abdomen
  - Injuries to the hands and extensor surface of the forearms
  - Pattern injuries

**Answer: B.** Signs of an intentional injury include a central location (ie, trunk and breasts), bilateral injuries (both arms or both legs), defensive injuries (ie, ecchymoses on the back of the hand as a result of protecting the face), and patterned injuries (having the markings of an object, such as the sole of a shoe or a burn with the imprint of an iron).

- 59.3.** Which of the following about a woman should alert the provider that the patient may be a victim of human trafficking, rather than IPV?
- Appears much younger than her stated age and does not have identification with her
  - Is accompanied by her partner who will not leave her side

- Is easily startled
- Is evasive in answering questions about her injuries
- Presents with a traumatic injury at night

**Answer: A.** Most of these situations apply to the IPV survivor and victim of human trafficking. Presentations that should alert the provider that the patient may be a victim of human trafficking rather than IPV include a person who looks much younger than her stated age (she often is younger). Other clues include a victim that does not have identification papers (the “employer” often takes these from the victims under the guise of “keeping the documents safe”), but this also prevents the victim from leaving without these documents. Untreated sexually transmitted infections (STIs, including pelvic inflammatory disease), malnourishment, and addiction to drugs and alcohol. It is important for the provider to consider the presentations of human trafficking, because although the victim may not be identified in the ED—for a number of reasons, including lack of trust and familiarity with the ED provider, the resources that may be helpful are somewhat different than those used by IPV survivors.

- 59.4.** Key management steps after identifying a patient experiencing IPV include which of the following?
- Creating a detailed and comprehensive safety plan
  - Emphasizing the importance of leaving the abuser immediately
  - Keeping the patient in the ED until she agrees to contact police and have a restraining order issued
  - Providing validation about disclosing the abuse
  - Reinforcing the importance of secrecy about the abuse until the woman has left the home

**Answer: D.** Emergency clinicians should validate the disclosure of abuse, emphasize that the victim is not at fault, and encourage future discussions with IPV community agencies or other health care providers. Immediate safety should be assessed, but most patients will not want to leave the abuser immediately; however, a positive initial conversation may begin the process of ending the abusive relationship. A templated list will allow the ED staff to create a basic safety plan with the patient; an individualized plan is best done in conjunction with trained domestic violence advocates, typically in follow-up.

## KEY CONCEPTS

- Assessment of airway patency, either by CT or flexible endoscopy, is important during assessment of deep space infections of dental origin. Patients with significant airway compromise should be intubated.
- Tissue infections are treated for 10 days with simple penicillin or ampicillin/sulbactam. For penicillin-allergic patients, use metronidazole or clindamycin.
- Fractures of teeth are managed differently depending on which structures are involved—enamel, dentin, or pulp exposure.
- Avulsed *permanent* teeth are reimplanted as quickly as possible and are best preserved in Hank's solution; primary teeth should not be reimplanted.

## CHAPTER 60: QUESTIONS &amp; ANSWERS

- 60.1.** A 27-year-old previously healthy man presents with dental pain and facial swelling. Physical examination is remarkable for trismus, poor dentition with diffuse periodontal disease, and inability to manage secretions. You determine endotracheal intubation is necessary. Which of the following statements regarding the patient's management is *true*?
- An awake intubation technique is indicated.
  - Pre-induction methocarbamol will decrease the trismus.
  - Rapid sequence induction with rocuronium is indicated.
  - Succinylcholine will worsen the trismus.
  - Transtacheal retrograde wire intubation is indicated.

**Answer: A.** The trismus is “mechanical,” or muscular. Neuromuscular blockade, regardless of the choice between depolarizing or non-depolarizing agents, is not likely to help. Awake intubation, using a videolaryngoscope or flexible endoscope is indicated. Transtracheal retrograde wire intubation is rarely, if ever, indicated in modern emergency practice. Traditional “muscle relaxants” are sedatives and have no direct muscle-relaxing properties.

- 60.2.** A 21-year-old man presents with tooth pain. He underwent a left mandibular premolar extraction 3 days ago. Examination is remarkable for a painful but nonbleeding tooth socket. The face and mandible are not swollen. Which of the following statements regarding this patient's condition is *true*?
- Analgesia is the main goal of emergency department (ED) therapy.
  - Antibiotics are indicated.
  - Dental consultation in the ED is indicated.
  - Opioids are the treatment of choice.
  - Provocation of socket bleeding is encouraged to form new clot.

**Answer: A.** A dry socket is an exquisitely painful post-extraction syndrome that typically occurs 3 or 4 days later. The pathophysiology is loss of the healing blood clot and localized bone infection. Treatment consists of pain control. Optionally, gentle irrigation, and packing with gauze soaked in eugenol can be performed. Opioids may be used, but this would be in addition to nonsteroidal antiinflammatory drugs (NSAIDs), which are excellent analgesics for dental pain and are preferred due to the inflammatory component.

- 60.3.** A 2-year-old previously healthy toddler presents with an avulsed tooth after hitting his mouth on the ground after a trip and fall. Physical examination is remarkable for a non-toxic appearing child who is crying and has an open slightly oozing pocket at the maxillary central incisor. Which of the following statements regarding the patient's management is *true*?
- Set-up for conscious sedation should be arranged, because the replacement of the avulsed tooth may be painful.
  - The mother should have the patient place the tooth in the patient's mouth.
  - The tooth should be placed in milk or Hank's balanced salt solution.
  - The tooth should be replaced in the socket as soon as possible.
  - The tooth should not be reimplanted.

**Answer: E.** Management of recovered avulsed teeth depends on the age of the patient and the length of time for which the tooth has been displaced. Avulsed primary teeth in a pediatric patient 6 months old to 6 years old are *not* replaced in the socket. Reimplanted primary teeth ankylose or fuse to the bone, so although the dentofacial complex grows downward and forward, the reimplantation site does not. There also may be interference with the eruption of the permanent tooth. Cosmetic deformity results in either case. Thus, this patient should be referred to a pedodontist for consideration of a space maintainer or cosmetic appliance.

- 60.4.** A 25-year-old previously healthy woman presents with recurrent pain from her temporomandibular joint disorder (TMD). The pain is described as being dull, and it worsens during the course of the day. Physical examination is remarkable for a non-toxic appearing female with normal dentition without any deformities but mild tenderness to palpation over the temporomandibular joint (TMJ) and some spasm noted over the masseter and internal pterygoid. Which of the following statements regarding the patient's management is *true*?
- A computed tomography (CT) scan of the face would be helpful.
  - A Panorex should be obtained.
  - Patient should be prescribed narcotic agents.
  - Treatment consists of external application of heat for 15 minutes four to six times per day, soft diet, analgesics including nonsteroidal antiinflammatory drugs (NSAIDs), and a muscle relaxant, such as diazepam (2 to 10 mg up to four times per day).
  - Ultrasound of the joint should be obtained.

**Answer: D.** TMJ radiographs are not helpful. Treatment consists of the external application of heat for 15 minutes four to six times per day, soft diet, analgesics including NSAIDs, and a muscle relaxant, such as diazepam (2 to 10 mg up to four times per day). Patients should be referred to a dentist specializing in TMD, such as a periodontist or a periodontal prosthodontist.

- 60.5.** A 32-year-old previously healthy man presents with a fractured maxillary lateral incisor after a mechanical trip and fall. Physical examination is remarkable for a portion of the tooth that has an ivory-yellow appearance. You determine that he has a fractured tooth. Which of the following statements regarding the patient's management is *true*?
- A.** A calcium hydroxide paste should be used to cover the exposed dentin.
  - B.** A dressing can be placed for comfort.
  - C.** An urgent pulpotomy is indicated.
  - D.** If this were a pediatric patient or an adolescent, it would be considered less serious, because children have more dentin than adults.
  - E.** The patient will likely need a subsequent root canal.

**Answer: A.** This patient has a fracture involving the dentin, which has an ivory-yellow appearance. The pulp continually lays down dentin throughout the life of the tooth. In a child, the pulp is relatively large in size, and there is less dentin; the inverse is true in the adult. Because dentin is a microtubular tissue capable of preventing bacteria to percolate into the pulp chamber, fractures involving dentin are more serious in children and adolescents. In younger patients, the management of dentin fractures involves the immediate placement of a dressing of calcium hydroxide paste over the exposed dentin. Early intervention may prevent contamination of the pulp and avoid the need for subsequent root canal. In an adult, who has a greater thickness of dentin compared with pulpal tissue, there is less need for urgent referral to a dentist. A dressing can be placed on the tooth for comfort. Referral should be made to a dentist for the next working day. Fractures involving pulp exposures are true dental emergencies.

## KEY CONCEPTS

- Routine prophylactic topical antibiotics are not indicated for the treatment of corneal abrasions, and eye patches are not recommended because they can mask a worsening infection.
- Eyelid lacerations that may require referral to a plastic or ophthalmic surgeon include those with lid margin lacerations, a canalicular laceration, or levator or canthal tendon injuries.
- Alkaline burns to the cornea and conjunctiva need to be copiously irrigated until a neutral pH is attained, because they produce a liquefactive necrosis that penetrates and dissolves tissue.
- Admission should be considered for traumatic hyphema patients with sickle cell trait, uncontrolled elevations in intraocular pressures (IOPs), hyphema of greater than 50%, and concern for re-bleeding.
- Any manipulation, palpation, or tonometry on a suspected globe rupture should be avoided, pending ophthalmological consultation and further examination.
- Scleritis, an autoimmune inflammatory process involving the sclera, can be confused with episcleritis, caused by inflammation in the more superficial episcleral layer of the eye. Episcleritis, unlike scleritis, is associated with much less discomfort, a pinker and more pronounced peri-limbal injection, and has injected superficial episcleral vessels that—unlike the deeper injected scleral vessels in scleritis—will vasoconstrict and blanch with 10% phenylephrine. Treatment of both involves topical corticosteroid drops.
- Endophthalmitis is an infection of the eye itself, and the most common etiology is recent intraocular surgery. Intravitreal antibiotics are indicated for endophthalmitis.
- Herpes zoster keratoconjunctivitis can complicate herpes zoster ophthalmicus, and necessitates emergent ophthalmologic consultation and treatment with systemic antiviral agents.
- The acute treatment of acute angle-closure glaucoma uses a two-armed approach: (1) reducing the production of aqueous humor with a topical beta-blocker (timolol 0.5%—1 to 2 gtt), a carbonic anhydrase inhibitor (acetazolamide 500 mg IV or PO), and a systemic osmotic agent (mannitol 1 to 2 g/kg IV); and (2) increasing the outflow of aqueous humor with a topical alpha-agonist (phenylephrine 1 gtt), miotic drops (pilocarpine 1% to 2%), and topical steroids (prednisolone acetate 1%, 1 gtt every 15 to 30 minutes four times, then every hour).
- With anisocoria, the following considerations help in the determination of which pupil—the larger or the smaller—is the pathological one: (1) parasympathetic innervation constricts a pupil in bright light, whereas sympathetic stimulation helps dilate a pupil in the dark; (2) an abnormally small pupil may therefore be due to either a decrease in sympathetic stimulation or an augmentation of parasympathetic stimulation—but likely the former (eg, Horner's syndrome); (3) an abnormally large pupil may therefore be due to either a decrease in parasympathetic stimulation or an augmentation of sympathetic stimulation—but likely the former (eg, partial third-nerve palsy from compression, Adie's pupil, pharmacological mydriasis); or (4) the abnormally small pupil will usually look worse in the dark, whereas the abnormally large pupil will usually look worse in the light.

## CHAPTER 61: QUESTIONS &amp; ANSWERS

- 61.1.** A 23-year-old male presents with left periorbital pain after being struck with a fist. On examination, there are no globe injuries but marked periorbital swelling is noted. Computed tomography (CT) of the face reveals an orbital floor fracture. Which of the following would be the most likely physical findings?
- Cheek anesthesia, enophthalmos, and limitation of upward gaze
  - Cheek anesthesia, ptosis, and limitation of inferior gaze
  - Forehead anesthesia and afferent papillary defect
  - Forehead anesthesia, diplopia, and limitation of lateral gaze
  - Ptosis, miosis, and ipsilateral anhidrosis

**Answer: A.** An orbital floor fracture may entrap the inferior rectus and inferior oblique muscles, resulting in diminished upward gaze. Other findings may include ptosis, enophthalmos, ipsilateral cheek/lip anesthesia, and orbital emphysema. Ten percent to 25% of such patients have associated globe injuries. Option E describes Horner's syndrome, which is not a typical finding.

- 61.2.** A 20-year-old male presents with periorbital pain and swelling after a blow to the eye by a softball. Physical examination reveals proptosis with blurred vision and limitation of ocular motion in all planes. Tonometry reveals an intraocular pressure (IOP) of 35 mm Hg. Which of the following should be the first indicated maneuver?
- Acetazolamide 500 mg IV, mannitol 20 g IV, and topical timolol
  - Computed tomography (CT) scan of the head and face
  - Endotracheal intubation and hyperventilation
  - Immediate lateral canthotomy and cantholysis
  - Ophthalmologic consultation

**Answer: D.** These findings should make one suspect retrobulbar hemorrhage. All of these interventions are likely indicated. Intraocular hypertension may compromise central retinal artery flow. Although immediate ophthalmologic consultation and pressure-lowering maneuvers are indicated, lateral canthotomy and cantholysis will provide the most rapid temporizing measure to preserve vision.

- 61.3.** A 43-year-old male presents with acute ocular pain after a splash injury from drain cleaner. What should be the sequence of interventions?
- Copious irrigation for 10 minutes, pH testing, cyclopentolate cycloplegia, topical antibiotics/intraocular pressure (IOP) measurement
  - Intravenous (IV) analgesia, cyclopentolate cycloplegia, IOP measurement, isotonic irrigation
  - IOP measurement, analgesia, head-up position, cycloplegia
  - Phenylephrine cycloplegia, isotonic irrigation for 10 minutes, pH testing, slit-lamp examination for foreign bodies
  - Phenylephrine cycloplegia, slit-lamp examination for foreign bodies, isotonic irrigation for 10 minutes, pH testing

**Answer: A.** Copious irrigation, ideally beginning at the scene, is the cornerstone of management. Nitrazine pH testing after 10 minutes should guide the need for continued irrigation. Cycloplegia, IOP measurement, and topical antibiotics come after pH normalization. Phenylephrine is contraindicated for cycloplegia in these cases because of its vasoconstrictive properties.

- 61.4.** A 17-year-old girl who wears contact lenses presents with a 24-hour history of right eye pain. Physical examination reveals a right corneal abrasion at the six-o'clock position of the limbus. Appropriate treatment consists of which of the following?
- Cessation of contact lens wear, eye irrigation (qid) with isotonic saline solution, followed by instillation of undiluted topical tetracaine for 5 days
  - Emergent ophthalmology consultation
  - Tetanus prophylaxis, eye patching for 48 hours, antibiotic ointment, and a 24-hour recheck
  - Tetanus prophylaxis, topical nonsteroidal anti-inflammatory drugs (NSAIDs), cessation of contact lens wear, and a 24-hour recheck
  - Topical nonsteroidal medications, topical antipseudomonal antibiotic, and a 24-hour recheck

**Answer: E.** Tetanus prophylaxis is not indicated for corneal abrasion unless there is corneal perforation or contamination with organic material. Topical NSAIDs reduce corneal abrasion pain. Antipseudomonas coverage with cessation of contact lens wear is appropriate. Eye patching is not indicated. Administration of undiluted topical anesthetics for more than 24 hours is untested and may be dangerous. Oral analgesics may be needed.

- 61.5. How do patients with subconjunctival hemorrhage most commonly present?
- A. Asymptomatic blood in the eye, noticed in the mirror or by a friend
  - B. Decreased visual acuity
  - C. Foreign body sensation
  - D. Modest pain
  - E. Photophobia

**Answer: A.** Any significant symptoms, such as pain, decreased vision, foreign body sensation, or photophobia, should spark the search for more serious pathology. Bilateral hemorrhage in the absence of a clear cause (eg, severe vomiting) should raise suspicion for coagulation issues.

- 61.6. A 38-year-old man presents with unilateral left-sided visual loss after a motor vehicle collision (MVC). The only clinical finding is a left-sided hyphema rising to 50% of the height of the anterior chamber. Intraocular pressure (IOP) is 17 mm Hg in the unaffected eye and 29 mm Hg in the affected eye. Appropriate management should include which of the following?
- A. Cycloplegia, intravenous (IV) mannitol, ophthalmology consultation
  - B. IV analgesia and antibiotic, immediate ophthalmologic consultation for decompression resulting from intraocular hypertension
  - C. Oral acetazolamide, patch and shield, antiemetics, 24-hour recheck
  - D. Topical beta-blocker, patch and shield, modest analgesia, admission
  - E. Topical beta-blocker, topical nonsteroidal anti-inflammatory drugs (NSAIDs) for pain, patch and shield, 24-hour recheck

**Answer: D.** Significant hyphema is an indication for admission. The presence of elevated IOP requires urgent treatment (which might also include topical alpha-agonists or IV acetazolamide, and so on), patch and shield, elevation of the head, and cautious use of systemic analgesics. Any form of platelet inhibition would be contraindicated (ie, NSAIDs).

- 61.7. What is the major complication of hyphema?
- A. Detached retina
  - B. Glaucoma
  - C. Horner's syndrome
  - D. Rebleeding
  - E. Vitreous hemorrhage

**Answer: D.** Rebleeding typically occurs 2 to 5 days later as the clot retracts. It is most common in patients with elevated intraocular pressures (IOPs), hyphema greater than 30% of the anterior chamber, and with delayed presentation. Rebleeding may lead to glaucoma and synechia formation.

- 61.8. A 48-year-old woman presents with right eye pain, photophobia, and decreased vision after a motor vehicle collision (MVC). Physical examination reveals an irregularly shaped pupil and a small hyphema. Photophobia, decreased acuity, minimal pupil reactivity, and bloody chemosis are seen on examination. What is the most likely diagnosis?
- A. Acute angle-closure glaucoma
  - B. Blunt ciliary injury
  - C. Iridodialysis
  - D. Scleral rupture
  - E. Traumatic miosis

**Answer: D.** Scleral rupture occurs either at the insertion of the extraocular muscles or at the limbus, where the sclera is the thin nest. A "teardrop" pupil is often seen and may be accompanied by bloody chemosis or severe subconjunctival hemorrhage. Brownish black pigment prolapse may also be seen. Intraocular pressure (IOP) may be low, but tonometry is generally contraindicated in cases of suspected globe injury.

- 61.9. A 26-year-old man presents with a 3-day history of right eye pain, decreased vision, and photophobia. He reports a history of left eye trauma 6 weeks prior, with hyphema, traumatic iritis, and persistent decreased vision. He is otherwise healthy. Physical examination reveals photophobia in the right eye with bilateral decreased vision. Before the past 3 days, the vision in the right eye had been perfect. What is the most likely explanation for his right eye symptom?
- A. Collagen vascular disease
  - B. Post-traumatic conjunctivitis
  - C. Post-traumatic retinal tear
  - D. Spontaneous vitreal hemorrhage
  - E. Sympathetic ophthalmia

**Answer: E.** Sympathetic ophthalmia is an autoimmune inflammatory response in the unaffected eye, days to months after uveal trauma in the opposite eye. Pain, photophobia, and decreased vision are common. This patient had no findings consistent with conjunctivitis or collagen vascular disease, and a retinal tear would not typically be painful.

- 61.10. Oral antibiotics are indicated for which of the following?
- A. Blepharitis
  - B. Chalazion
  - C. Dacryocystitis
  - D. Endophthalmitis
  - E. Hordeolum

**Answer: C.** Dacryocystitis is an infection of the lacrimal sac from nasolacrimal duct obstruction. Warm compresses are also recommended and may be helpful, although evidence is lacking. Warm compresses and topical antibiotics are appropriate for the other conditions. Intravitreal antibiotics are indicated for endophthalmitis.

- 61.11. Emergency department (ED) bedside ocular ultrasonography can provide useful information for which of the following conditions?
- A. Lens dislocation
  - B. Retinal detachment
  - C. Vitreous hemorrhage
  - D. All of the above

**Answer: D.** A displaced lens can be seen in the relatively hypoechoic vitreous. Vitreous hemorrhage and retinal detachment can both be diagnosed with ED bedside ultrasonography.



## KEY CONCEPTS

- Most cases of AOM resolve spontaneously. Nontoxic children from 6 months to 2 years of age with unilateral AOM and those older than 2 years with unilateral or bilateral AOM may be observed for 3 days to determine whether antibiotics are required. When indicated, amoxicillin is the initial choice for treatment of AOM, 80 to 90 mg/kg per day.
- Otitis externa is treated with topical antibiotic drops. Only fluoroquinolone drops are FDA-approved for use when a tympanic perforation may be present. Necrotizing OE should be considered in immunocompromised patients who have persistent otitis externa.
- Patients with epistaxis with posterior nasal packing should be admitted to the hospital.
- Bullous myringitis is caused by the usual organisms that cause otitis media.
- Adult patients with AOM should be treated with amoxicillin, 500 mg tid.
- The diagnosis of AOM is made by a bulging TM and signs and symptoms of acute infection.
- Acute hearing loss is most often idiopathic. A 10- to 14-day steroid taper is usually prescribed but is not known to provide benefit.
- Hoarseness or an unexplained neck mass that persists for longer than 2 weeks requires ENT referral.

## CHAPTER 62: QUESTIONS &amp; ANSWERS

**62.1.** Which of the following clinical symptoms is most useful in diagnosing acute otitis media (OM)?

- A. Cough
- B. Decreased appetite
- C. Ear pain
- D. Fever
- E. Vomiting

**Answer: C.** Although all the symptoms of acute OM are nonspecific, ear pain appears to be the most useful.

**62.2.** A 56-year-old man presents with sudden onset of hearing loss in his left ear. He also complains of tinnitus. His neurologic examination is otherwise unremarkable. What should be the next step in the patient's management?

- A. Consult a neurologist.
- B. Consult an otolaryngologist.
- C. Obtain a head computed tomography (CT) scan.
- D. Obtain a magnetic resonance imaging (MRI) scan with gadolinium.
- E. Start a steroid taper.

**Answer: B.** Sudden sensorineural hearing within 72 hours is considered an otolaryngologic emergency. The evaluation and potential treatment options, including steroids, hyperbaric oxygen, and antiviral agents, are best performed in consultation with an otolaryngologist.

**62.3.** A 30-year-old woman presents with onset of a severe right posterior occipital headache and low-grade fever. Her physical examination reveals an area of erythema and swelling posterior to the right ear and a nonmobile tympanic membrane in that ear. What is the most appropriate next diagnostic step?

- A. ENT referral STAT to the operating room (OR)
- B. CT scan
- C. Lumbar puncture
- D. MRI with gadolinium
- E. No further diagnostic evaluation necessary

**Answer: B.** Clinical findings in acute mastoiditis may include fever, headache, otalgia, and posterior auricular erythema and tenderness. Although there are no specific diagnostic criteria, an initial step would be a CT scan to identify mastoid inflammation and possible bony erosion. MRI would be indicated if there is concern for intracranial extension.

**62.4.** All the following are implicated as risk factors in OM except:

- A. Children with cleft palate
- B. Daycare attendance
- C. Female gender
- D. Immunocompromised patient
- E. Parental smoking

**Answer: C.** Male gender appears to be a risk factor for middle ear disease, as well as daycare attendance, parental smoking, immunocompromised patients, and children with anatomic abnormalities such as cleft palate or Down syndrome. Breast-feeding appears to be protective.

**62.5.** An 18-month-old boy returns to the emergency department (ED) 4 days after being diagnosed with left OM. He was prescribed amoxicillin, 90 mg/kg/day, and the parents reported compliance. He has continued ear tugging, fever, and irritability. He is tolerating PO nutrition with no vomiting or diarrhea. Physical examination reveals an alert crying male with oral temperature 101.5°F, heart rate 136 beats/min, and respiratory rate 24 breaths/min. His physical examination is otherwise negative except for severe erythema of the left tympanic membrane, with obscure landmarks and loss of mobility. What is the most appropriate next step in this patient's management?

- A. Admit for intravenous antibiotics.
- B. Change therapy to an oral cephalosporin.
- C. Draw blood cultures and continue current amoxicillin regimen.
- D. Intramuscular ceftriaxone is given.
- E. Lumbar puncture is performed.

**Answer: D.** Otitis media treatment failures at 3 days should receive intramuscular ceftriaxone. Continued use of a failing regimen would not be indicated. The child exhibits no signs or symptoms warranting a lumbar puncture and no immediate criteria for hospital admission.

- 62.6. A 13-year-old diabetic girl presents with left otalgia, left facial palsy, and fever. Physical examination reveals a left peripheral seventh nerve palsy, intense left otitis externa, diffuse tenderness of the pinna, and mild weakness of the left trapezius muscle. What is the most likely diagnosis?
- A. Acute mastoiditis
  - B. Left temporal brain abscess resulting from left-sided otitis
  - C. Malignant otitis externa
  - D. Meningitis
  - E. Sigmoid sinus thrombosis

**Answer: C.** Necrotizing (malignant) otitis externa is a result of chronic otitis externa often seen in immunocompromised patients. The facial nerve is the cranial nerve usually affected, but the glossopharyngeal, vagal, accessory, abducens, and trigeminal nerves may also be involved. When otoscopic view permits, granulation tissue in the floor of the external canal at the bone–cartilage junction is characteristic. CT is the imaging technique of choice and is able to indicate bony erosions and abscess formation. Ciprofloxacin is the antibiotic of choice. All the other choices are recognized complications.

- 62.7. The management of anterior and posterior epistaxis is similar regarding which of the following?
- A. Antibiotic requirements after packing
  - B. Duration of packing
  - C. Indications for hospitalization
  - D. Surveillance for secondary complications
  - E. Value of topical cauterization

**Answer: C.** Strong evidence for postpacking of antibiotics are lacking in both situations. Anterior packs are left in place for approximately 48 hours, whereas posterior packs may require 3 to 5 days. Patients requiring posterior nasal packs for epistaxis typically need hospitalization for supplemental oxygen and surveillance for pack expulsion with rebleeding, dysrhythmias, bradycardia, aspiration, and stroke.

- 62.8. Which of the following statements is true regarding inspiratory stridor?
- A. It implies a palatal or uvula obstruction.
  - B. It is diagnostic of tracheal pathology.
  - C. It is typically accompanied by hoarseness.
  - D. It localizes a lesion at or above the vocal cord.
  - E. It may be seen with extremely severe asthma exacerbations.

**Answer: D.** Inspiratory respiratory distress (stridor) implies an extrathoracic flow obstruction. This may be laryngeal, epiglottitis, or pharyngeal. Asthma, emphysema, and aspirated foreign bodies all have expiratory airflow limitations. Inspiratory stridor may or may not directly involve the larynx and may not be accompanied by hoarseness.

## KEY CONCEPTS

- Inhaled and systemic steroid medications are effective in controlling airway inflammation and have important roles in management of asthma exacerbations.
- Inhaled bronchodilators and systemic corticosteroids remain as the mainstays of management for most acute asthma exacerbations.
- Theophylline is the main oral methylxanthine used to treat asthma, and we do not recommend its use for acute disease because of lack of demonstrated efficacy and increased adverse events.
- Critical asthma syndromes (CASs) require rapid identification. Treatment must be aggressive and may use strategies not used in mild to moderate exacerbations, such as infusion of magnesium sulfate, use of noninvasive ventilation, and endotracheal intubation.
- Ventilator management in the intubated asthmatic is critical and includes lower tidal volumes (6 to 8 mL/kg) and low respiratory rates, often less than 10 per minute.
- A normal partial pressure of carbon dioxide ( $P_{CO_2}$ ) in a pregnant patient represents hypercarbia.
- Elevated lactic acid levels are common in critically ill asthmatics and do not reflect deterioration or a poor prognosis.
- ED management of acute asthma is expanding (up to 24 hours) as more non-critically ill asthmatics are treated in observation units.
- Integration of discharged patients with acute asthma into chronic management strategies to prevent relapse requires that asthma patients' physicians be familiar with controlling medications, such as ICSs and leukotriene modifiers.

## CHAPTER 63: QUESTIONS &amp; ANSWERS

- 63.1.** A 33-year-old woman presents with a first-ever episode of shortness of breath, nonproductive cough, and wheezing. She had been previously healthy but experienced a mild upper respiratory infection 1 month ago, followed by chronic nasal congestion, conjunctival infection, rhinorrhea, and decreased sense of smell. This episode of cough and wheezing started 2 days ago. Inspection reveals a healthy appearing woman with mild respiratory distress: temperature, 97.5°F (36.4°C) oral; blood pressure, 110/70 mm Hg; respiratory rate, 24 breaths per minute; and oxygen saturation, 95%. Physical examination is remarkable for diffuse moderate expiratory wheezes. Chest radiograph is negative. What is the most likely diagnosis?
- Aspirin-exacerbated respiratory disease (AERD)
  - Atypical pneumonia
  - Bronchitis
  - Maxillary sinusitis
  - Pulmonary aspergillosis

**Answer: A.** This is a classic adult-onset sequence presentation for AERD. Aspirin sensitivity and periodic asthma flares typically follow this apparent upper respiratory infection–induced cycle. Clinically significant sinusitis might be expected to show facial pain/tenderness with fever. Bronchitis may present with broncho spasm, but the nasal and ocular symptoms do not fit. Pulmonary aspergillosis would likely occur in an immunosuppressed patient or very chronic asthmatic.

- 63.2.** Periodic asthma flares may be precipitated by which of the following?
- Increased production of prostaglandin  $E_2$  ( $PGE_2$ )
  - Falling leukotriene levels
  - Falling progesterone levels
  - Rising estrogen levels
  - Thyroid hormone fluctuations

**Answer: C.** Menstrual-induced asthma is likely triggered by falling progesterone levels just prior to menstruation. Estrogen may likewise exert a salutary bronchodilating effect. Elevated levels of the inflammatory mediator leukotriene are the hallmark of chronic asthma. Cyclo-oxygenase inhibition by nonsteroidal anti-inflammatory drugs (NSAIDs) and falling  $PGE_2$  levels may explain part of the aspirin-induced asthma syndrome.

- 63.3.** A 30-year-old woman with a history of asthma presents with a typical asthma flare that has progressed slowly over 16 hours. Which of the following is true?
- Airway obstruction is probably more predominant than airway inflammation.
  - Most cases of asthma exacerbations in adults have a much more rapid and abrupt onset.
  - Response to treatment would be expected to be rapid.
  - Steroids are less likely to be helpful.
  - The episode was likely triggered by an upper respiratory infection.

**Answer: E.** Slow-onset asthma typically occurs in females. This phenotype represents 80% of cases. There is a primary inflammatory mechanism, and response to treatment is slower. Abrupt-onset asthma more typically occurs in males and is bronchospastic, exercise or stress induced, and more rapidly responsive to treatment.

- 63.4.** Which of the following is a risk factor for sudden death from asthma?
- A hospitalization for asthma in the past year but not within the past 30 days
  - An emergency department (ED) visit for asthma in the past year but not within the past 30 days
  - Current use of systemic corticosteroids
  - Patient perception that the current exacerbation is very severe
  - Use of over-the-counter medications

**Answer: C.** Risk factors for sudden death are current or recent corticosteroid use, ED or hospitalization within the past 30 days, more than two hospitalizations for asthma in the past year, more than three ED visits for asthma in the past year, using more than two beta-agonist canisters per month, previous intubation or intensive care unit (ICU) visit, and difficulty perceiving symptoms or their severity.

**63.5.** A 23-year-old man with known severe asthma presents with an acute asthma flare over 2 hours. Physical examination reveals a well-developed man in marked respiratory distress. Heart rate is 120 beats per minute, oxygen saturation is 90%, respiratory rate is 26 breaths per minute, blood pressure is 140/92 mm Hg, and oral temperature is 98.7°F (37.2°C). Current medications are albuterol metered-dose inhaler (MDI) and fluticasone inhaler 500 µg twice daily. What therapy is recommended for this acute flare?

- A. Albuterol 2.5 mg nebulized, methylprednisolone 125 mg intravenously, and magnesium sulfate 3 g intravenously
- B. Epinephrine infusion at 5 µg per minute
- C. Ipratropium 500 µg nebulized × three doses with methylprednisolone 125 mg intravenously
- D. Methylprednisolone 125 mg intravenously with salmeterol nebulized via continuous nebulization
- E. Terbutaline 0.25 mg subcutaneously, ipratropium 500 µg nebulized, and methylprednisolone 125 mg intravenously

**Answer: A.** Short-acting inhaled beta-agonists, with or without anticholinergics (ie, ipratropium), are the cornerstone of acute asthma management. Corticosteroids are indicated in any moderate or severe flare. Oral steroids are as efficacious as intravenous (IV) steroids if the patient can take oral medications. Magnesium sulfate may obviate the need for intubation in severe cases. Sal meterol is a slow-onset, long-acting beta-2 agonist (LABA) not indicated in acute asthma management.

**63.6.** What is the medication combination of choice for the rapid sequence induction of an asthmatic?

- A. Etomidate/succinylcholine
- B. Ketamine/succinylcholine
- C. Midazolam/pancuronium
- D. Propofol/rocuronium
- E. Thiopental/succinylcholine

**Answer: B.** No choice is contraindicated. Ketamine is the sedative of choice because of its bronchodilatory effect. Propofol may have this same benefit, although less profound. Thiopental releases histamine, and etomidate does not bronchodilate. Succinylcholine releases trace amounts of histamine, but this is not known to cause any adverse effect. Rocuronium has an onset time similar to that of succinylcholine, no histamine release, and a prolonged duration of action. Either succinylcholine or rocuronium is acceptable for rapid sequence intubation (RSI) in acute asthma.

**63.7.** Which of the following is a risk factor for death in patients presenting with an asthma attack?

- A. Currently taking theophylline
- B. Family history of asthma
- C. Presence of symptoms for 1 week
- D. Recently ran out of inhaled corticosteroid (ICS)
- E. Use of three albuterol metered-dose inhalers (MDIs) per month

**Answer: E.** The following are risk factors for death from asthma:

- Past history of sudden severe exacerbations
- Prior intubation for asthma
- Prior asthma admission to an intensive care unit (ICU)
- Two or more hospitalizations for asthma in the past year

- Three or more emergency department (ED) care visits for asthma in the past year
- Hospitalization or an ED care visit for asthma within the past month
- Use of more than two MDI short-acting beta-2 agonist canisters per month
- Current use of or recent withdrawal from systemic corticosteroids
- Difficulty perceiving severity of airflow obstruction
- Comorbidities such as cardiovascular diseases or other systemic problems
- Serious psychiatric disease or psychosocial problems
- Illicit drug use, especially inhaled cocaine and heroin

**63.8.** A 25-year-old woman presents with wheezing and shortness of breath from asthma. She was recently exposed to cigarette smoke. She denies cough and fever. You cannot get much more of a history from her at this time because she finds it difficult to speak in complete sentences. Her vital signs are: blood pressure, 136/85 mm Hg; heart rate, 110 beats per minute; respiratory rate, 32 breaths per minute; and temperature, 99°F (37.2°C). Her oxygen saturation is 92%. Her peak expiratory velocity-1 is 50% of predicted percentage. On physical examination, you note bilateral wheezing, regular tachycardia, and accessory muscle use. The remainder of her examination is normal. Over the course of 1 hour, she receives supplemental oxygen, three doses of nebulized albuterol (5 mg) mixed with ipratropium (0.5 mg), and oral prednisone 60 mg. She now reports feeling somewhat better. She speaks in longer sentences but still cannot speak in complete sentences. A repeat peak flow measurement is now 60% of predicted. Otherwise, there are no changes on a repeat physical examination. You plan to admit her to your ED observation unit. What is an appropriate next step in the management of this patient?

- A. Additional nebulized albuterol
- B. Intravenous (IV) magnesium sulfate
- C. IV methylprednisolone (Solu-Medrol)
- D. Oral montelukast
- E. Subcutaneous terbutaline

**Answer: A.** This patient presents with a moderate-to-severe asthma exacerbation. She has responded to initial therapy but continues to have moderate symptoms. Additional adrenergic medications are indicated. Because she is tolerating nebulized medications and is responding, there is no need for IV or subcutaneous adrenergics, such as terbutaline. IV magnesium sulfate is a smooth muscle relaxant, but it is generally reserved for more severe asthma exacerbations. Oral and IV steroids have the same efficacy, and regardless of the route, only need to be administered every 6 to 8 hours. Montelukast is a leukotriene-modifying drug that is used in chronic management. Studies are ongoing with the use of these medications in acute exacerbations of asthma. They may improve pulmonary function tests (PFTs), but they do not change rates of admission or adverse outcomes.

## KEY CONCEPTS

- Acute exacerbation of chronic obstructive pulmonary disease (COPD) is defined by a worsening of the patient's respiratory symptoms that is beyond normal day-to-day variations, requiring a change in medication.
- Cigarette smoking remains the most important single cause for developing COPD. However, genetic syndromes, occupational exposures, passive smoke inhalation, biomass heating fuels in poorly ventilated areas, and air pollution are also important contributory risk factors worldwide.
- Consider other life-threatening diagnoses in the acute exacerbation COPD patient who does not respond to standard treatments. Such diagnoses include acute heart failure, pulmonary embolism (PE), pneumonia, mucous plugs, and pneumothorax. Emergency clinicians should maintain a high index of suspicion for lung malignancy in COPD patients.
- The most common dysrhythmias associated with COPD are atrial fibrillation and multifocal atrial tachycardia. Classic electrocardiogram (ECG) findings for COPD include P pulmonale, low QRS voltage, and poor R wave progression but none of these findings are sufficiently sensitive or specific for COPD and should not be relied upon to make the diagnosis.
- Noninvasive ventilator support/bi-level positive airway pressure (BiPAP) is an accepted and effective alternative to invasive ventilation in COPD patients with moderate to severe COPD exacerbation. However, BiPAP cannot substitute for invasive ventilation in patients who are hemodynamically unstable, markedly agitated, and uncooperative or in whom respiratory arrest appears inevitable.
- The most important factor in the decision to intubate is the patient's clinical status, not arterial blood gas (ABG) measurements. Even in the face of a significant rise in partial pressure of carbon dioxide ( $PCO_2$ ) with oxygen administration, intubation may be unnecessary if the patient's clinical status has stabilized.
- The three classes of medications most often used in the management of acute COPD exacerbations are bronchodilators, steroids, and antibiotics.
- Bronchodilators, such as albuterol (short-acting beta-2 receptor agonist) and ipratropium bromide (anticholinergic), are considered first-line agents in the treatment of acute exacerbation COPD and may provide a synergistic treatment effect.
- Acute exacerbation COPD patients should receive systemic corticosteroids. Oral and intravenous (IV) forms demonstrate similar efficacy, but patients who are unable to tolerate the oral form due to respiratory failure or *per os* (by mouth; PO) intolerance should receive the IV form.
- Antibiotics should be administered to all acute exacerbation COPD patients requiring both intensive care unit (ICU) and non-ICU admission. In discharged patients, the emergency clinician should consider antibiotics if the patient has an increase in sputum purulence and either increased dyspnea or increased sputum volume.
- Although there is some evidence that IV magnesium sulfate may play a role in potentiating the bronchodilatory effects of beta-agonists, there is currently insufficient high quality evidence to recommend routine administration of IV or inhaled magnesium in the treatment of COPD in the emergency department (ED).
- Currently there is no role for methylxanthines, heliox, or respiratory stimulants in the management of COPD patients in the ED.

## CHAPTER 64: QUESTIONS &amp; ANSWERS

- 64.1. Which of the following statements regarding smoking and chronic obstructive pulmonary disease (COPD) is true?
- Approximately 50% of COPD patients have a significant smoking history.
  - Progression can be reliably predicted in percentages per year.
  - Smoking cessation fairly reliably halts progression of COPD.
  - Smoking results in a destructive inflammatory cascade very similar to that seen in asthmatics.
  - The minority of smokers eventually develop airflow limitation.

**Answer: E.** Most smokers do not get airflow limitations. Genetic and environmental factors play important roles. The destructive inflammatory process, once initiated, continues to some degree despite smoking cessation. This cascade, as compared with asthma, involves neutrophils rather than eosinophils, different leukotrienes, and tumor necrosis factor expression. Progression cannot be precisely predicted.

- 64.2. Frequent chronic obstructive pulmonary disease (COPD) exacerbations can be anticipated when a patient's baseline forced expiratory volume in one second ( $FEV_1$ ) falls below which of the following?
- 75%
  - 50%
  - 25%
  - 10%
  - There is no correlation.

**Answer: B.** This corresponds to stage 3/stage 4 COPD.

- 64.3. What is the most frequent etiology for chronic obstructive pulmonary disease (COPD) exacerbation?
- Bacterial
  - Environmental
  - Idiopathic
  - D. Viral
  - Other systemic illnesses

**Answer: D.** Idiopathic accounts for approximately 30%. The role of bacterial pathogens is unclear, with chronic colonization suggesting a greater role in the chronic progression rather than acute flares. Environmental causes play a role, but this is difficult to define.

- 64.4. A 69-year-old man with known chronic obstructive pulmonary disease (COPD) presents with an acute 2-day flare of his disease. Current medications are albuterol inhaler, amlodipine 10 mg/day for hypertension, and furosemide 40 mg/day. His primary symptoms are exertional dyspnea and cough with a change to yellow sputum production from clear. Vital signs are: blood pressure, 160/100 mm Hg; respiratory rate, 24 breaths per minute; heart rate, 120 beats per minute; oral temperature, 98.4°F (36.9°C); and oxygen saturation, 91%. Chest radiograph shows hyperinflation with no infiltrate. Electrocardiography (ECG) shows multifocal atrial tachycardia (MAT). Which of the following is true?

- As for acute bronchitis, antibiotics are of no benefit for acute COPD exacerbation.
- Beta-agonist and corticosteroid treatment mirror recommendations for acute asthma flares.
- If endotracheal intubation is required, ventilatory settings to maintain a partial pressure of oxygen ( $PO_2$ ) greater than 60 mm Hg and a partial pressure of carbon dioxide ( $PCO_2$ ) 40 mm Hg or less are recommended.
- Outpatient management is indicated.
- Pharmacologic intervention should be initiated early for rate control of MAT.



**Answer: B.** The dosing of beta-agonists and corticosteroids is very similar to guidelines for asthma. Unlike acute bronchitis, COPD patients who have experienced a change in sputum production often benefit from empirical antibiotics. MAT does not typically require treatment and often resolves as the COPD flare is ameliorated. Mechanical ventilation of COPD patients is aimed acutely at maximizing oxygenation, with as low a forced inspiratory oxygen ( $\text{FiO}_2$ ) as possible while slowly normalizing  $\text{Pco}_2$  levels over many hours via permissive hyper-apnea to allow acid-base normalization and avoidance of generation of excessive intrathoracic pressures by high ventilating rates. Hypoxemia and abnormal heart rhythm mandate inpatient care.

- 64.5.** The addition of B-type natriuretic peptide (BNP) to the initial evaluation of patients with acute dyspnea will do which of the following?
- A. Be normal in cases of acute pulmonary embolus
  - B. Help differentiate right from left heart failure in chronic obstructive pulmonary disease (COPD) patients with some degree of heart failure
  - C. Rarely be helpful
  - D. Reliably help identify patients whose symptoms are caused by exacerbation of congestive heart failure (CHF)
  - E. Result in a smaller number of patients being treated for CHF regardless of the cutoff value used

**Answer: D.** The addition of a BNP level to the evaluation of COPD patients may benefit when taken in the context of the clinical impression. By establishing a cutoff value, the majority of CHF patients will be identified, but at any cutoff, there will be false positives. The BNP cannot differentiate left versus right ventricular stretch and strain and may not be normal in cases of pulmonary embolus because of the right ventricular stretch.

- 64.6.** A 34-year-old man presents with 3 days of severe sore throat and painful swallowing. He reports his symptoms are worsening. His vital signs are: blood pressure, 127/85 mm Hg; heart rate, 132 beats per minute; respiratory rate, 22 breaths per minute; and temperature, 100.8°F (38.2°C). On physical examination, he is sitting upright and is noted to be spitting his saliva into a cup. On lung examination, you note good air movement but inspiratory stridor. The remainder of his physical examination is within normal limits. As you begin preparations for airway management, which antibiotic is appropriate?
- A. Amoxicillin
  - B. Azithromycin
  - C. Ceftriaxone
  - D. Doxycycline
  - E. Rifampin

**Answer: C.** This patient has epiglottitis by history and physical examination. Adult patients with epiglottitis have higher mortality than pediatric patients, secondary to delayed diagnosis. The most important and time-sensitive intervention is airway management. Once a decision has been made about airway management, it is important to initiate prompt treatment of the infection. *Haemophilus influenzae* is the most commonly isolated bacterial pathogen, and thus treatment should be aimed at this pathogen. Staphylococci, streptococci, and viruses have also been implicated. Ceftriaxone and cefotaxime are commonly used first-line agents. Another option would be medications from the fluoroquinolone class. Up to 50% of *H. influenzae* isolates are resistant to amoxicillin (because of beta-lactamase production). Resistance is also a problem with both azithromycin and doxycycline, so they are not appropriate first-line agents. Although rifampin has activity against *H. influenzae*, resistance develops, and this agent should not be used as monotherapy. After initial coverage, culture and sensitivity results should be used to guide therapy.

## KEY CONCEPTS

- Most cases of pharyngitis have a viral causes. CENTOR clinical criteria in conjunction with RST can be used to determine the likelihood of GAS pharyngitis.
- Rheumatic fever is rare in developed countries, where it may occur in epidemics.
- Although rare, local (airway) and systemic life-threatening complications of bacterial pharyngitis do occur.
- A severe sore throat with surprisingly minimal findings on examination of the oropharynx suggests serious soft tissue infection, such as epiglottitis or retropharyngeal abscess.
- Deep space cellulitis is difficult to differentiate from deep space abscess and may require needle aspiration after CT or MRI.
- Patients with upper airway infections should be kept in a position of comfort. Patients with epiglottitis prefer the classic sniffing position, whereas those with a retropharyngeal abscess prefer to lie supine.
- Posterior to the retropharyngeal space lies the danger space, which extends from the base of the skull to the superior mediastinum at about the level of T2.
- Resolving pharyngitis followed by severe sepsis, right-sided endocarditis, or aspiration pneumonia should suggest septic thrombosis of the internal jugular vein and Lemierre's syndrome.
- Imaging is rarely indicated in the setting of sinusitis and should be reserved for complex presentations or if there is a suspicion of complications.
- In children with persistent and stable sinusitis, a 3-day period of observation prior to the initiation of antibiotics is effective.

## CHAPTER 65: QUESTIONS &amp; ANSWERS

65.1. Which of the following associations regarding pharyngitis is true?

- A. Appears clinically well—diphtheria
- B. Cervical adenopathy—influenza
- C. Conjunctivitis—coxsackievirus
- D. No pharyngeal exudates—infectious mononucleosis
- E. Pharyngeal exudates—adenovirus

**Answer: E.** Adenovirus often mimics streptococcal pharyngitis regarding the appearance of the exudate. It is also associated with conjunctivitis, rather than coxsackievirus, which is associated with hand-foot-and-mouth disease. Influenza rarely shows cervical adenopathy or pharyngeal exudates. Infectious mononucleosis typically exhibits a tonsillar exudate or membrane. Diphtheria cases are usually toxic-appearing.

65.2. A 9-year-old boy presents with fever, neck tenderness, and painful swallowing. The physical examination reveals a well-developed boy in no distress with oral temperature, 39.2°C (102.6°F), heart rate, 125 beats/min, respiratory rate, 22 breaths/min, blood pressure, 100/60 mm Hg, and O<sub>2</sub> saturation, 99%. Examination reveals whitish bilateral tonsillar exudates, tender bilateral cervical adenopathy, clear lungs, and normal tympanic membranes. Appropriate treatment measures include which of the following?

- A. Admission for intravenous antibiotics
- B. Amoxicillin daily for 10 days
- C. Discussion with the family that antibiotic treatment prevents rheumatic fever but does not shorten illness duration
- D. Symptomatic treatment only
- E. Symptomatic treatment, throat culture, and return visit within 3 to 4 days for culture review and antibiotics as indicated

**Answer: B.** A 10-day course of penicillin or cephalosporin is the treatment of choice. The antibiotic regimen of choice for adults with group A beta-hemolytic *Streptococcus* (GAS) pharyngitis is a single intramuscular injection of 1.2 million units of benzathine penicillin. Culture and follow-up visits are acceptable practice but time-consuming and expensive. Symptomatic treatment is only indicated when GAS has been ruled out. Antibiotic treatment prevents rheumatic fever and modestly shortens illness duration.

65.3. A 10-year-old boy, who recently immigrated to the United States from Honduras, complains of 3 days of sore throat, fever, and trouble swallowing. Examination reveals a healthy boy in mild distress with a grayish membrane covering the soft palate, pharynx, and uvula. The airway is patent. The child is slightly hoarse. He has bilateral tender anterior cervical adenopathy; his lungs are clear. Vital signs are temperature, 102.5° F (39°C) oral, heart rate, 130 beats/min, blood pressure, 105/65 mm Hg, respiratory rate, 28 breaths/min, and O<sub>2</sub> saturation 100%. Which of the following treatments is most appropriate?

- A. Antitoxin
- B. High-dose corticosteroids
- C. High-dose intravenous penicillin
- D. Nebulized racemic epinephrine treatments
- E. Urgent endotracheal intubation

**Answer: A.** This is diphtheria. Urgent antitoxin is necessary. The toxin may produce airway collapse, vocal cord necrosis, neuritis, and carditis. Antibiotics eradicate only the carrier state. Corticosteroids do not affect the toxin-induced damage. The status of the child does not warrant emergent endotracheal intubation because his hoarseness is only mild and he has a patent airway, although he must be closely monitored.

65.4. A 14-year-old girl returns to the ED 1 week after completing a 10-day course of penicillin for rapid strep test–confirmed GAS pharyngitis. She reports identical symptom return 1 week after completion of her antibiotics. Examination is again consistent with an exudative pharyngitis. Which of the following is indicated?

- A. Admission for intravenous antibiotics
- B. Cephalosporin, 10-day course
- C. Counseling the family that this is likely infectious mononucleosis and symptomatic treatment is warranted
- D. Intramuscular benzathine penicillin, 1.2 million units
- E. Repeat rapid strep testing

**Answer: D.** Such patients may have been noncompliant or reinfectured by asymptomatic contacts. Throat culture, surveillance of contacts, and intramuscular penicillin are indicated.

## KEY CONCEPTS

- Empirical antimicrobial therapy should be started in the ED for patients admitted with pneumonia.
- Empirical therapy should treat the most likely pathogens for the clinical situation, such as *S. pneumoniae*, *H. influenzae*, *M. pneumoniae*, and *C. pneumoniae*, and should be consistent with current national treatment guidelines, such as those from the ATS/IDSA.
- HIV or other immunosuppressive conditions should be considered for all patients in whom pneumonia is suspected.
- Disposition is dictated by the patient's underlying medical conditions, severity of illness, likelihood of clinical deterioration, and feasibility of home care and outpatient follow-up.
- No characteristic radiographic pattern is pathognomonic for a specific pneumonia pathogen.
- *Legionella* should be suspected in patients with gastrointestinal or neurologic symptoms presenting with pneumonia.

## CHAPTER 66: QUESTIONS &amp; ANSWERS

66.1. Which of the following statements regarding community-acquired pneumonia (CAP) is true?

- Among hospitalized adults with CAP, *Streptococcus pneumoniae* and *Haemophilus influenzae* account for most cases.
- Chlamydomphila* is the most common atypical agent causing severe pneumonia.
- Clinical history and prodrome often lead to organism identification.
- S. pneumoniae* is the most common pathogen among those requiring intensive care unit (ICU) admission.
- Viral causes are seen in approximately 40% of cases.

**Answer: D.** *Pneumococcus* and *H. influenzae* account for 25% of cases of hospitalized CAP. Viral causes are seen in approximately 18% of cases, although there is uncertainty about this figure because most patients are not tested for specific viruses. *Legionella*, rather than *Chlamydia*, causes the most severe pneumonia among the atypicals. There is no clinical history or symptom complex that reliably allows organism identification.

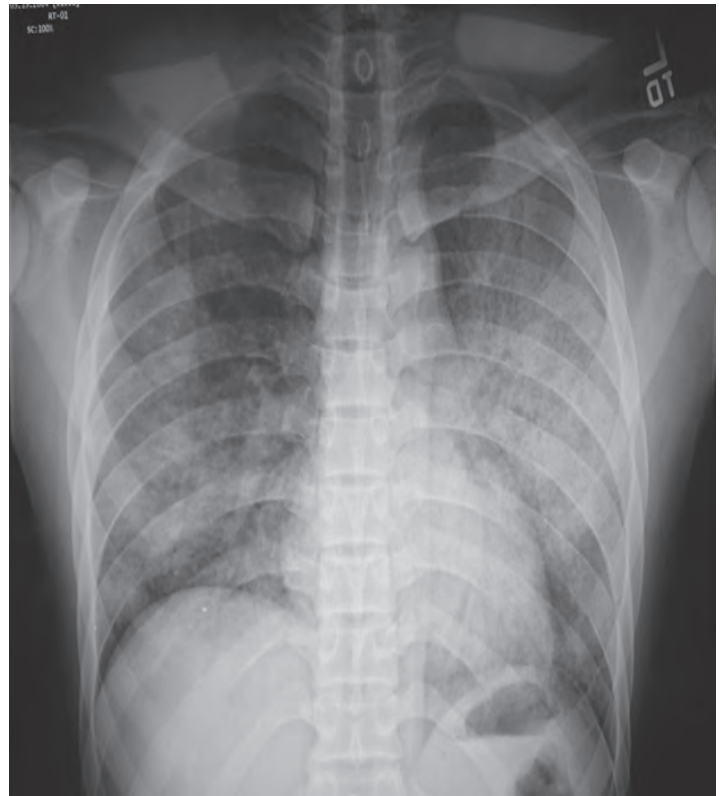
66.2. Which of the following associations is correct?

- Cytomegalovirus (CMV) pneumonia—immunosuppression, adults
- Influenza pneumonia—summer, adults
- Mycoplasma pneumoniae*—winter, infants
- Parainfluenza pneumonia—spring, infants
- Varicella zoster pneumonia—winter, military recruits

**Answer: A.** CMV pneumonia rarely occurs in healthy people and is typically seen in the immunosuppressed patient, such as a transplant patient. Varicella pneumonia is associated with smoking and pregnancy in adults. Influenza and parainfluenza typically occur in winter months. *Mycoplasma pneumoniae* is typically a disease of adolescents and adults.

66.3. A 26-year-old landscaper presents with chronic cough with intermittent fevers. He has no other past medical history. The symptoms began 2 months ago after a 7- to 10-day prodrome of cough with productive sputum, for which he received a macrolide without improvement. Physical examination and vital signs are normal. The chest radiograph is shown here. What is the most likely cause for this process?

- Histoplasma capsulatum*
- Klebsiella pneumoniae*
- Pneumocystis jiroveci*
- Sarcoidosis
- Streptococcus pneumoniae*



**Answer: C.** *Histoplasma capsulatum*, *Blastomyces dermatitidis*, and *Coccidioides immitis* are fungi present in the soil in various geographic areas. They are most common in people engaged in soil-disturbing activities, such as construction or dirt bike racing trials, and should be considered when patients fail to respond to antibacterial treatment. The chest radiograph shows asymmetric hilar adenopathy and left-sided cavitation with fibrotic changes. Sarcoidosis would clinically show symmetrical adenopathy. *Klebsiella* is rarely seen in healthy adults. *Pneumocystis jiroveci* would be a possibility if the patient were known or suspected to be infected with human immunodeficiency virus (HIV), but a 2-month history would be uncommon.

**66.4.** The potential for opportunistic pulmonary infection can be predicted by an absolute CD4 lymphocyte count less than which of the following?

- A. 50/mm<sup>3</sup>
- B. 100/mm<sup>3</sup>
- C. 150/mm<sup>3</sup>
- D. 200/mm<sup>3</sup>
- E. 250/mm<sup>3</sup>

**Answer: D.** This count is often found in patients with HIV infection or may be estimated by a peripheral total lymphocyte count less than 1000/mm<sup>3</sup>.

**66.5.** A 60-year-old man with a past medical history of adult-onset diabetes controlled with glyburide presents with cough, weakness, and purulent sputum production. Vital signs are temperature 38.3°C (101°F) oral, heart rate, 130 beats/min, blood pressure, 85/50 mm Hg, respiratory rate, 30 breaths/min, and oxygen saturation, 91%. The chest radiograph reveals a consolidated left lower lung (LLL) pneumonia. What is the most appropriate antibiotic therapy?

- A. Ceftriaxone plus levofloxacin plus vancomycin
- B. Ceftriaxone with a macrolide
- C. Fluoroquinolone only
- D. Trimethoprim-sulfamethoxazole (TMP-SMX)
- E. Vancomycin only

**Answer: A.** In patients requiring hospitalization for CAP, coverage for CAP would typically be with a fluoroquinolone or combination of a macrolide with a  $\beta$ -lactam. Because this patient has signs of severe sepsis, consideration should be given to the addition of an agent for methicillin-resistant *Staphylococcus aureus* (MRSA; vancomycin) in addition to CAP coverage.

**66.6.** Which of the following causative agents of pneumonia would be an indication for respiratory isolation when suspected?

- A. *Histoplasma capsulatum*
- B. *Mycobacterium tuberculosis*
- C. *Pneumocystis jiroveci*
- D. *Staphylococcus aureus*
- E. *Streptococcus pneumoniae*

**Answer: B.** Any patient for whom tuberculosis is a suspected possibility should be placed in respiratory isolation in a negative-pressure room until it can be ruled out by acid-fast bacilli (AFB) smears. The other listed organisms do not require respiratory isolation.

## KEY CONCEPTS

- Point of care thoracic ultrasound can be used to rule out pneumothorax with greater sensitivity than a portable supine chest x-ray examination. Chest CT is the gold standard for diagnosis of pneumothorax but is reserved for cases in which pneumothorax is highly suspected and the chest x-ray is negative.
- For healthy young patients with a small (<20%) primary spontaneous pneumothorax, observation alone (with administration of 100% oxygen) is an appropriate treatment option; for larger symptomatic pneumothoraces, simple aspiration with an intravenous catheter is often successful.
- In most cases of secondary spontaneous pneumothorax, tube thoracostomy should be considered because less invasive approaches are associated with lower rates of success.
- The routine application of suction after tube thoracostomy is no longer recommended and does not accelerate lung reexpansion.
- The most common cause of pleural effusions in the West is congestive heart failure, followed by malignancy and bacterial pneumonia; however, the diagnosis of PE should not be overlooked in a patient with pleural effusion of unknown cause.
- Therapeutic thoracentesis is indicated for the relief of acute respiratory or cardiovascular compromise and should be performed under ultrasound guidance, if possible.
- The clearest indication for diagnostic thoracentesis in the ED is to diagnose immediately life-threatening conditions, such as empyema or esophageal rupture in a toxic patient. In most other cases, diagnostic thoracentesis to distinguish between transudative and exudative processes can be deferred.
- On a frontal (anteroposterior or posteroanterior) projection, a volume of at least 200 mL of pleural fluid is required before radiographic demonstration is possible. However, ultrasound can detect as little as 50 mL of pleural fluid and can be easily performed at the bedside.

## CHAPTER 67: QUESTIONS &amp; ANSWERS

67.1. What is the most common condition associated with secondary spontaneous pneumothorax in adults?

- A. Chronic obstructive pulmonary disease
- B. Collagen vascular disease
- C. *Pneumocystis* pneumonia
- D. Pulmonary malignancy
- E. Severe asthma exacerbation

**Answer: A.** Chronic obstructive pulmonary disease is the most common condition associated with secondary spontaneous pneumothorax, although all the conditions listed may also be causes.

67.2. Which of the following describes intrapleural pressure in relation to atmospheric pressure during normal spontaneous ventilation?

- A. Inspiration, positive; expiration, negative
- B. Inspiration, positive; expiration, positive
- C. Inspiration, negative; expiration, negative
- D. Inspiration, negative; expiration, positive
- E. The relationship is variable and altitude-dependent.

**Answer: C.** In relation to atmospheric pressure, normal intrapleural pressure is approximately 10 mm Hg during inspiration and 2 mm Hg during expiration. Intrabronchial pressures are similarly negative during inspiration but rise to slightly positive during expiration. This largely negative intrapleural force maintains lung expansion and promotes venous return to the heart, which is greater during inspiration.

67.3. Which of the following may differentiate spontaneous pneumomediastinum from spontaneous pneumothorax?

- A. Cough
- B. Occurrence during exertion
- C. Pain
- D. Tachycardia
- E. Tachypnea

**Answer: B.** Spontaneous pneumomediastinum, unlike pneumothorax, often occurs with exertion, particularly after a strenuous Valsalva maneuver. Signs and symptoms—pain, cough, tachycardia, and tachypnea—are similar in the two conditions.

67.4. A 29-year-old, otherwise healthy man presents with acute onset of right pleuritic chest pain and modest cough. The symptoms occurred at rest. Physical examination is remarkable only for a tachycardia of 108 beats/min. Chest radiography reveals an estimated 30% right pneumothorax. Review of symptoms and past history are negative. Which of the following would be suitable management?

- A. Admission for 100% face mask oxygen and repeat radiography in 1 day
- B. Endotracheal intubation
- C. One-time air aspiration and repeat radiography in 6 hours

- D. Reassurance and observation
- E. Tube thoracostomy

**Answer: C.** Observation is typically indicated for primary spontaneous pneumothoraces less than 20%. Larger primary spontaneous cases may be treated with aspiration and repeat chest radiography. Advantages include lower cost and morbidity and lack of invasiveness. Success rates range from 45% to 71%. Tube thoracostomy is indicated for most cases of secondary spontaneous pneumothorax and if any pleural fluid is present.

67.5. Which of the following statements is true regarding the routine application of suction after tube thoracostomy?

- A. It improves the rate of lung expansion.
- B. It increases the risk of reexpansion pulmonary edema.
- C. It is associated with increased rates of empyema.
- D. It is not routinely indicated.
- E. When indicated, it should be applied with a pressure of at least 10 cm H<sub>2</sub>O.

**Answer: D.** Suction neither accelerates lung reexpansion nor improves outcomes. It is indicated when reexpansion with a Heimlich or water seal device does not occur after 24 to 48 hours. A pressure of at least 20 cm H<sub>2</sub>O should be used.

67.6. A 68-year-old man with a history of esophageal cancer presents with progressive fever, chest pain, and shortness of breath over 24 hours. Chest radiography demonstrates a possible left lower lobe pneumonia and large left pleural effusion. Pleural fluid analysis reveals pH of 6.95, glucose level of 47 mg/dL, 11,500 white blood cells (WBCs)/mm<sup>3</sup> (82% neutrophils), and protein level 75% of plasma levels. What are the indicated next steps in management?

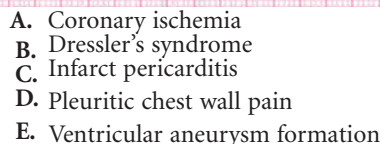
- A. Antibiotics and fluid resuscitation
- B. Antibiotics and tube thoracostomy
- C. Antibiotics, tube thoracostomy, and esophageal Gastrografin study
- D. One-time pleural aspiration for fluid analysis
- E. Pleural Gram staining and culture and tube thoracostomy if infection is confirmed

**Answer: C.** This is an exudative pleural effusion as defined by Light's criteria (see Box 67.3). A pH less than 7.0 suggests empyema or esophageal rupture. This patient is at risk for both; hence, the need to assess esophageal integrity. A pH less than 7.0 with glucose level less than 50 mg/dL are indications for tube thoracostomy. Normal pleural fluid has a WBC count of less than 1,000/mm<sup>3</sup>.



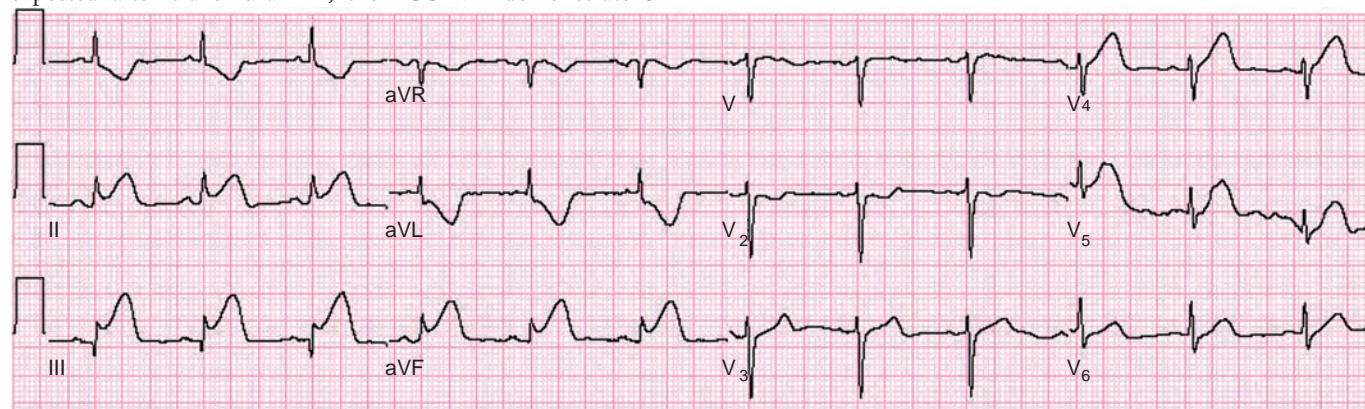
- Angina-equivalent symptoms that are not characteristically associated with ACS vary widely and often distract from the diagnosis. The patient's age, diabetes status, ethnicity, and gender are considered with an atypical history.
- Limitations of the 12-lead ECG in ACS include initial nondiagnostic findings, evolving fluctuations with ongoing symptoms, anatomic myocardial blind spots, and confounding or obscuring patterns, such as LBBB.
- Patients with proximal left anterior descending artery stenosis (Wellens syndrome) may have deeply inverted or biphasic T waves in the anterior precordial leads.
- ST segment elevation in lead aVR more than 0.5 mV suggests left main coronary artery disease.
- Functional testing strategies for ACS include graded exercise testing, echocardiography, and myocardial scintigraphy. Graded exercise testing, with or without nuclear scintigraphy, can be used in the patient with low to moderate likelihood of CAD who is able to exercise. Myocardial scintigraphy with pharmacologic stress can be used in the debilitated or older patient (ie, unable to exercise). Echocardiography with pharmacologic stress is appropriate for the woman older than 45 years, the patient with diabetes mellitus, and the patient with other forms of organic heart disease (eg, valvular dysfunction, low cardiac output states).
- The use of coronary CT angiography is most appropriate in the younger patient; excessive coronary calcification can reduce the ability of CCTA to evaluate the patient for significant CAD reliably.
- Fibrinolysis is not effective in patients with STEMI who are in cardiogenic shock.
- Unless used for rate control of supraventricular dysrhythmia in a patient who cannot tolerate beta blockade, calcium channel blockade is not recommended for those with ACS.

**68.1.** A 40-year-old man presents with a 3-hour history of left-sided chest pain, slightly worse in the supine position, associated with mild dyspnea and diaphoresis. He is 2 weeks status post–left anterior/lateral subendocardial myocardial infarction (MI), with acute stenting of the left anterior descending and circumflex arteries. He is unable to discern if this pain is the same as his original cardiac pain. His current medications are aspirin, 81 mg/day, lovastatin, 80mg/day, amlodipine 10 mg/day, and clopidogrel 75mg/day. His electrocardiogram (ECG) is shown here. Cardiac troponin I is within normal limits. Vital signs are temperature, 38°C oral, heart rate (HR), 110 beats/min, blood pressure (BP), 153/96 mm Hg, respiratory rate (RR), 22 breaths/min, and O<sub>2</sub> saturation, 96%. What is the most likely diagnosis?



segment elevation, usually with prominent Q waves and T waves of diminished amplitude. Myocardial ischemia is a possibility, but troponin is negative and ECG is noncontributory.

**68.2.** A 37-year-old male renal dialysis patient presents with a 6-hour history of intermittent left-sided chest pain. He missed his last dialysis session due to feeling ill. His past history is significant for hypertension with secondary renal failure, tobacco use, and hypercholesterolemia. His current medications are amlodipine, 10 mg/day, a statin, and his renal failure medications. Vital signs are temperature, 36.7°C oral, HR, 92 beats/min, BP, 170/110mm Hg, RR, 22 breaths/min, and O<sub>2</sub> saturation, 95%. His ECG is shown below. The serum potassium level is 5.8 mEq/L. What is the most important intervention?



- A. Calcium gluconate, 1 g IV, followed by dextrose, 100 g, and regular insulin, 10 units IV
- B. Emergent dialysis
- C. IV enoxaparin
- D. IV metoprolol
- E. Nitroglycerin, aspirin, 325 mg orally, and cardiology consultation

**Answer: E.** The ECG shows asymmetric hyperacute T waves, possibly consistent with coronary ischemia. This is clinically the early electrocardiographic manifestation of AMI. The differential diagnosis of hyperacute T waves is ischemia, hyperkalemia, benign early repolarization, left ventricular hypertrophy, left bundle branch block, and pericarditis. The asymmetry of the T waves argues for ischemia, as does the relatively modest rise in the serum potassium. Enoxaparin might be indicated, but only as part of an acute coronary regimen with appropriate renal dosing. Beta blockers would worsen his hyperkalemia and would have to be carefully considered before administration.

**68.3.** A 63-year-old woman with a past medical history of diabetes presents with altered mental status, diaphoresis, and substernal chest pain for 4 hours. Vital signs are HR, 96 beats/min, BP, 80/50 mm Hg, RR, 26 breaths/min, temperature, 37°C, and O<sub>2</sub> saturation, 94%. The ECG clearly demonstrates a large, anterior, ST segment elevation MI. Your institution does not have a cardiac catheterization laboratory. The closest hospital with a cardiac catheterization laboratory is 2 hours by ground, and no aircraft is available due to weather. After normal saline boluses, what is the most appropriate treatment?

- A. Administer aspirin, PSY<sub>12</sub> inhibitor, intravenous (IV) unfractionated heparin (UFH), vasopressor therapy as needed, and admit to your institution.
- B. Administer aspirin, PSY<sub>12</sub> inhibitor, IV UFH, and immediate transfer to primary percutaneous coronary intervention (PCI) center by ground emergency medical services (EMS).
- C. Administer aspirin, PSY<sub>12</sub> inhibitor, IV UFH, IV fibrinolysis, and immediate transfer to the PCI center.
- D. Administer aspirin, PSY<sub>12</sub> inhibitor, IV UFH, and transfer to the primary PCI center when helicopter becomes available in 4 hours.

**Answer: B.** Patients who present with ST segment elevation myocardial infarction (STEMI) and cardiogenic shock should be preferentially treated with percutaneous coronary intervention (PCI) if there are no contraindications to mechanical reperfusion. Because PCI is the preferred therapy, a delay of beyond the usual threshold of 60 to 120 minutes from first medical contact to PCI for the administration of fibrinolytics is tolerated. Although a delay beyond 120 minutes is tolerable, it should be as small as possible.

**68.4.** A 48-year-old man with history of hypertension and hypercholesterolemia presents with chest pain and hyperacute T waves in an anterior distribution on the initial ECG. During your initial history and physical examination, the patient experiences ventricular fibrillation that responds to cardiopulmonary resuscitation (CPR) and defibrillation after being pulseless for a period of 3 minutes. Following cardiac arrest, the patient is comatose, with the following vital signs: HR, 110 beats/min, BP, 160/98 mm Hg, RR, 12 breaths/min (intubated), temperature, 36.5°C, and O<sub>2</sub> saturation, 96%. A repeat ECG demonstrates a large, evolving anterior STEMI.

Which of the following treatment plans is most appropriate?

- A. Administer aspirin, PSY<sub>12</sub> inhibitor, IV UFH, IV fibrinolysis, and admission to intensive care unit (ICU)
- B. Administer aspirin, PSY<sub>12</sub> inhibitor, IV UFH, IV fibrinolysis, initiation of therapeutic hypothermia, and admission to ICU
- C. Neurologic examination for brain death and admission to palliative care because outcome almost universally fatal
- D. Rapid revascularization with percutaneous coronary intervention (PCI), initiation of therapeutic hypothermia, and admission to ICU for comprehensive postresuscitation care
- E. Supportive care, and admission to ICU

**Answer: D.** A neurologic examination immediately following cardiac arrest is poorly prognostic of a favorable neurologic outcome with modern postresuscitation care. The sharp increase in survival with a favorable neurologic outcome has elevated rapid revascularization with percutaneous coronary intervention (PCI) and immediate application of therapeutic hypothermia as part of comprehensive postresuscitation care as a class I ACC/AHA recommendation. Although not contraindicated, fibrinolysis is inferior to PCI following cardiac arrest and should only be used when a patient is not a candidate for PCI.

**68.5.** Which of the following is an absolute contraindication to fibrinolytic therapy?

- A. Age older than 75 years
- B. Appendectomy performed 2 months ago
- C. Previous coronary artery bypass grafting (CABG)
- D. Previous hemorrhagic stroke
- E. Systolic blood pressure of 175/90 mm Hg following administration of vasoactive agents

**Answer: D.** Although patients older than 75 years have a higher risk of intracerebral hemorrhage, age should not be considered a contraindication to fibrinolysis. Although prior CABG patients should be preferentially considered for PCI, there is no contraindication to fibrinolytic use in these patients if PCI is not available. Systolic blood pressure above 150 mm Hg is a risk factor for intracerebral hemorrhage. Only hypertension persistently above 200/120 mm Hg, despite reasonable efforts, should be considered an absolute contraindication. Recent major surgery or trauma is a relative contraindication for fibrinolysis; however, the term *recent* is variably defined in the fibrinolytic literature and never as more than 6 weeks.

**68.6.** Which of the following drugs provides mortality benefit in the setting of AMI?

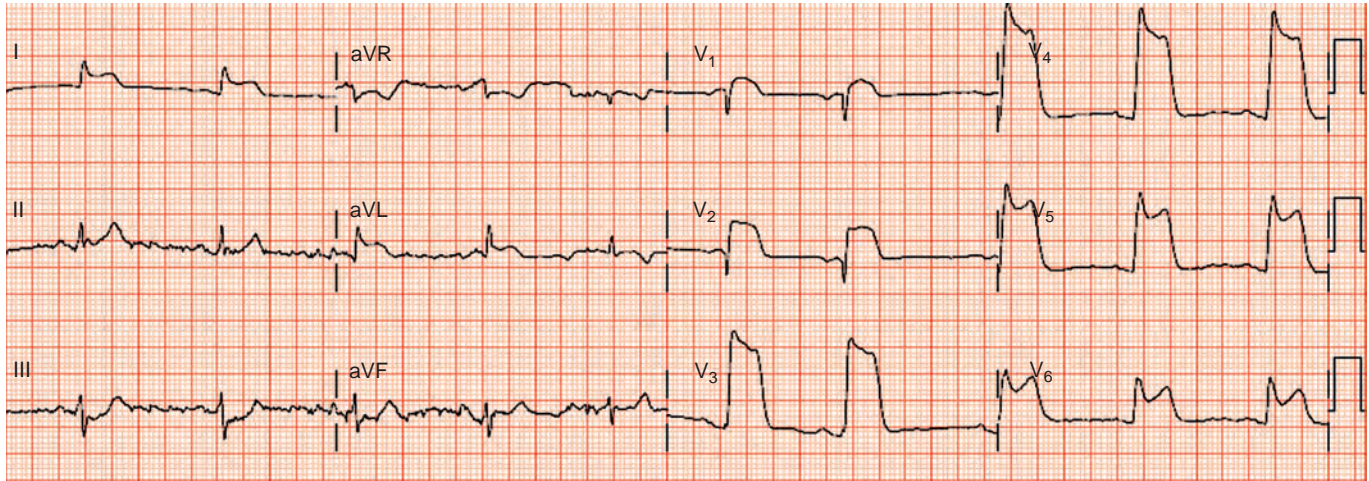
- A. Aspirin
- B. Intravenous beta blocker
- C. Intravenous morphine
- D. Nitroglycerin
- E. Oxygen

**Answer: A.** The ISIS-2 trial has demonstrated that aspirin independently reduces mortality by 23% in the setting of AMI. Intravenous morphine has not been shown to improve mortality and has been associated with mortality. Although nitroglycerin does improve symptoms and cause vasodilation, it has never been proven to improve mortality. Oxygen beyond that needed to maintain an oxygen saturation of 94% has been associated with additional mortality. The use of intravenous beta blockers does not offer significant benefit and is associated with an increased rate of adverse events.



68.7. A 42-year-old male patient presents with 45 minutes of chest pain. The ECG is depicted below. You are working at a noninvasive (ie, no PCI capability) hospital; transfer time to the closest major medical center with PCI

capability is 4.5 hours considering weather and logistics. The patient has no contraindications for fibrinolysis. Which of the following statements is most appropriate?



- A. The patient must be transferred rapidly to the closest PCI center, with initiation of appropriate  $\beta$ -adrenergic blocking agents and antiplatelet and anticoagulant therapies before transfer.
- B. The patient should receive a fibrinolytic agent followed by appropriate antiplatelet and anticoagulant therapies with admission to your hospital's ICU.
- C. The patient should receive a fibrinolytic agent followed by appropriate antiplatelet and anticoagulant therapies, with transfer to the closest PCI center for immediate PCI.
- D. The patient should receive a fibrinolytic agent followed by appropriate antiplatelet and anticoagulant therapies, with transfer to the closest PCI center within 24 hours for reevaluation and consideration of immediate PCI.

**Answer: D.** The ECG demonstrates an extensive anterolateral STEMI. The patient is young and has presented early in the STEMI evolution. This patient is at extreme risk due to the extensive nature of the STEMI and yet can benefit significantly from early reperfusion therapies. A delay of more than 60 to 120 minutes in this patient is not appropriate for the initiation of reperfusion therapies; furthermore, he is a candidate for a fibrinolytic agent. The early initiation of reperfusion therapy (fibrinolysis or PCI) is vital to reduce morbidity and mortality. Such a significant delay in this case for PCI is not justified, so a fibrinolytic agent is preferred. On arrival at the closest PCI center, the patient can be evaluated for PCI if he has not demonstrated successful reperfusion with resolution of chest discomfort and normalization of the ST segment elevation.

## KEY CONCEPTS

- Electrical therapy is used for any unstable patient in whom a dysrhythmia is the cause of symptoms—pacing if the heart rate is slow, countershock with sedation if fast.
- Assume that any regular, new-onset, symptomatic, wide-complex tachycardia is VT until proven otherwise.
- Type II second-degree AV block is never a normal variant and implies a conduction block below the AV node. When the conduction ratio is 2:1, assume that type II block exists until proven otherwise and have pacing readily accessible.
- Consider an accessory pathway syndrome in anyone with tachycardia exceeding a rate of 225 to 250 beats/min, regardless of the QRS complex morphology, and avoid nodal blocking agents.
- Look closely for irregularity in tachycardia over 200 beats/min; this and underlying atrial fibrillation can be missed if R-R intervals at fast rates are not carefully tracked.

## CHAPTER 69: QUESTIONS &amp; ANSWERS

- 69.1.** What is the primary electrochemical difference between pacemaker and nonpacemaker cells?
- A. Lack of a plateau phase 3 in nonpacemaker cells
  - B. Rapid phase 0 upstroke in nonpacemaker cells after stimulus
  - C. Slow calcium ion influx during phase 2 for pacemaker cells
  - D. Slow phase 4 spontaneous depolarization in pacemaker cells
  - E. Transient membrane repolarization by potassium channel closure during phase 1 for pacemaker cells

**Answer: D.** The spontaneous return to a depolarization threshold during phase 4 (diastole) characterizes pacemaker cells. Both cell types then exhibit a rapid phase 0 upstroke resulting from sodium ion ( $\text{Na}^+$ ) influx, brief repolarization resulting from potassium ion ( $\text{K}^+$ ) efflux (phase 1), plateau phase resulting from balanced calcium ion ( $\text{Ca}^{2+}$ ) entry and  $\text{K}^+$  efflux (phase 2), and then repolarization resulting from  $\text{Ca}^{2+}$  channel closure and  $\text{K}^+$  efflux (phase 3).

- 69.2.** For a reentrant tachydysrhythmia to occur, what three conditions exist?
- A. Electrolyte disturbance, ischemia, and altered conduction in an endogenous atrioventricular pathway
  - B. Electrolyte disturbance, two conduction pathways, with one of the pathways being slower
  - C. Ischemia, two conduction pathways, with one of the pathways being slower
  - D. Two conduction pathways, one path being slower, and differing responsiveness
  - E. Two conduction pathways with equal responsiveness

**Answer: D.** Remember that a conducting pathway is bidirectional. In a typical scenario, the alpha pathway of the atrioventricular (AV) node is the anterograde conducting limb, and the beta pathway is the retrograde conducting limb. Reentrant dysrhythmias are almost always AV nodal and narrow complexes that start and end abruptly.

- 69.3.** Classic antifibrillatory effects are seen with which class of antidysrhythmic?
- A. IA
  - B. IB
  - C. IC
  - D. II
  - E. III

**Answer: E.** Class III agents, of which amiodarone is the prototype, prolong the action potential and refractory period duration. Class I agents have variable effects on depolarization rate and repolarization duration.

- 69.4.** The most frequent proarrhythmic effects are seen with which class of antidysrhythmic?
- A. IA
  - B. IB
  - C. IC
  - D. II
  - E. III

**Answer: C.** Class IC agents, such as flecainide, encainide, and propafenone, markedly slow depolarization and conduction and prolong repolarization and action potential duration. Class IB agents generally have the least proarrhythmic effect.

- 69.5.** A 49-year-old woman presents with a sudden onset of palpitations and shortness of breath. This has happened once before. She has no past history and takes no medications. Vital signs are temperature,  $36.0^\circ\text{C}$  ( $96.8^\circ\text{F}$ ) oral, blood pressure, 115/69 mm Hg, heart rate 156 beats/min, respiratory rate 24 breaths/min, and oxygen ( $\text{O}_2$ ) saturation, 98%. Her electrocardiogram (ECG) is shown in Fig. 69.28. What is the most appropriate intervention?
- A. Adenosine, 6 mg IV
  - B. Digitalis, 0.25 mg IV
  - C. Diltiazem, 0.4 mg/kg IV
  - D. Propranolol, 1 mg IV
  - E. Synchronized electrical cardioversion after IV sedation with midazolam

**Answer: A.** Adenosine causes slowing of conduction in the anterograde and retrograde pathways, with no effect on ventricular contractility. It converts a high percentage of narrow-complex tachycardias to sinus rhythm, but with a 25% recurrence rate. Diltiazem would not be unreasonable, but the quoted dose is too high. Calcium channel blockers also exert their effects only on the anterograde pathway, with little direct effect on accessory pathways. Contractility may be diminished. Digitalis use has been largely supplanted by adenosine and class IV agents. Its onset of action after IV use is 1.5 to 2 hours. Cardioversion would not be indicated unless the patient exhibited hemodynamic instability.

## KEY CONCEPTS

- Pacemaker malfunction soon after implantation (within 6 to 8 weeks) is usually a result of a lead problem, such as a lead displacement, or a pacemaker programming failure, such as a pacing rate too slow for the patient's needs.
- Pacemaker malfunction arises in a limited number of ways: failure to pace, oversensing, undersensing, and pacing at an inappropriate rate (too fast or too slow).
- With lithium-iodine batteries, abrupt failure is an unlikely cause of pacemaker malfunction.
- If a patient with a pacemaker has a fever of unclear cause, pacemaker lead infection and endocarditis should be considered.
- Because paced ventricular complexes are conducted with a left bundle branch block pattern, a paced rhythm obscures the electrocardiographic diagnosis of acute myocardial infarction. A right bundle branch pattern is abnormal and suggests lead displacement.
- Magnet application does not turn off a pacemaker; it turns off the sensing or inhibition function. Fixed-rate pacing that is independent

of or in competition with the underlying native rhythm will ensue. Removal of the magnet restores the inhibitory activity of the pacemaker and returns it to demand pacing mode.

- Defibrillation is safe in patients with a pacemaker or implantable cardioverter-defibrillator (ICD). Paddles should be placed at least 10 cm from the subcutaneous implant site of the device. Alternatively, anteroposterior defibrillation with adhesive defibrillation electrodes can be performed. There are no reports of injury to rescuers from ICD discharges during manual chest compressions.
- Most left ventricular assist device (LVADs) do not produce pulsatile flow; therefore, these patients will not have a palpable pulse. Because chest compressions may be harmful, multiple methods should be used to confirm absence of circulation and attempts should be made to correct mechanical pump malfunction.
- Patients with a total artificial heart (TAH) have no native heart and no cardiac electrical activity. Electrocardiogram (ECG) for the TAH will read asystole. Defibrillation and pacing will not be effective. Chest compressions will not be effective and may be harmful.

## CHAPTER 70: QUESTIONS &amp; ANSWERS

- 70.1.** Which of the following conditions is an indication for permanent pacemaker placement after acute myocardial infarction?
- Asymptomatic persistent third-degree atrioventricular (AV) block
  - New-onset left bundle branch block
  - Symptomatic persistent second-degree infranodal AV block
  - Transient symptomatic third-degree AV block

**Answer: C.** Symptomatic persistent *symptomatic* second- or third-degree AV block and bilateral bundle branch block with persistent second-degree AV block at the His-Purkinje level are also indications.

- 70.2.** Which of the following technical characteristics is applicable for most permanent pacemakers?
- A unipolar pacemaker configuration is less prone to oversensing of myopotentials.
  - Bipolar systems are implantable cardioverter-defibrillator (ICD) compatible.
  - Lithium battery life is 10 to 20 years.
  - Most leads are implanted within the myocardium.
  - Optimal ventricular lead placement is at the right ventricular outflow tract.

**Answer: B.** Bipolar systems have the proximal (positive) and distal (negative) leads in close proximity to each other on the surface of the endocardium. Bipolar leads are more fracture prone but less likely to oversense myopotentials and are also ICD compatible. In unipolar systems, the proximal lead is enclosed in the pulse generator. Typical lithium battery life is 4 to 10 years. Unipolar lead amplitude is approximately four times longer than typical bipolar spikes (20 mm vs. 5 mm). Lead placement should not be in the outflow tract.

- 70.3.** A 72-year-old man presents with dyspnea. He has a history of symptomatic bradycardia that required pacemaker placement and a history of hypertension and peripheral vascular disease. In the course of your evaluation, an electrocardiogram (ECG) is obtained showing a ventricular-paced rhythm with a right bundle branch morphology, rate 72. Vital signs are normal. This likely indicates which of the following?
- A nonfunctioning atrioventricular (AV) sequential system
  - A ventricular demand pacemaker
  - Electrolyte disturbance
  - Lead displacement
  - Right ventricular apex depolarization by a unipolar endocardial lead

**Answer: D.** The typical depolarization begins in the right ventricular apex, and a left bundle branch pattern is the norm. The presence of a right bundle branch block (RBBB) pattern should raise suspicion of lead displacement. Electrolyte disturbance does not typically cause a morphology change.

- 70.4.** A 60-year-old man presents with swelling and tenderness around his left subclavian pacemaker. It was implanted 2 years previously for heart block. It was last interrogated 8 weeks prior by his cardiologist, with good function documented. Physical examination is unremarkable except for mild tenderness with minimal swelling and erythema at the pulse generation site. Vital signs are unremarkable. Which of the following interventions should be performed next?
- A course of oral antibiotics with *Staphylococcus aureus* coverage should be initiated.
  - Blood cultures should be sent.
  - Local aspiration should be considered to rule out hematoma.
  - Serial examinations would be acceptable management.

**Answer: B.** The incidence of wound/pocket infection is 1% or 2%. With infection, however, the incidence of bacteremia is 20% to 25%. Local signs may be minimal. If pacemaker site infection is suspected, blood cultures, admission for intravenous (IV) antibiotics, and cardiology consultation with the potential need for pacemaker explantation should be undertaken.

- 70.5.** What is the incidence of venous obstruction after permanent transvenous pacemaker placement?
- <15%
  - 15% to 30%
  - 30% to 50%
  - 50% to 70%

**Answer: C.** This may be partial or complete and involve the axillary, subclavian, innominate veins, or the superior vena cava (SVC). Because of collateralization, only approximately 4% of patients develop symptoms consistent with acute thrombosis. Thrombolytic therapy is most useful within the first 2 weeks.



**70.6.** Which of the following statements best describes risk of pacemaker syndrome in patients receiving a permanent pacemaker?

- A.** It is most common with VVI pacemakers.
- B.** It is not seen with dual-chamber pacing systems.
- C.** It occurs in less than 5% of patients after pacemaker placement.
- D.** It occurs in the setting of preexisting congestive heart failure (CHF).

**Answer: A.** Pacemaker syndrome occurs in approximately 20% of pacemaker recipients. It is due to poor atrioventricular (AV) synchrony occurring when the ventricle is paced, but an intact sinus node stimulates the atria to fire against closed tricuspid and mitral valves. CHF symptoms and elevated B-type natriuretic peptide (BNP) may be seen. It occurs less commonly with DDI systems, but when it does occur, it may require reprogramming for better AV synchrony. It is most common after VVI placement.

**70.7.** A 72-year-old woman presents in cardiac arrest. Her history is remarkable for automatic implanted cardiac defibrillator (AICD) implantation 6 months ago for recurrent ventricular tachycardia (VT). No other history is available. The rhythm is ventricular fibrillation (VF). Which of the following is next best steps?

- A.** Her cardiac arrest is indicative of implanted cardiac defibrillator (ICD) failure.
- B.** ICD should not be inactivated because of the high incidence of post resuscitation ventricular dysrhythmias.
- C.** Rescuers should be warned of potential painful shocks while performing cardiopulmonary resuscitation (CPR).
- D.** Transthoracic defibrillation may be performed in the standard manner for VF.

**Answer: D.** ICD does not prevent sudden death, as evidenced by the 2% annual incidence. Cardiac arrest is not an indication of ICD failure, because shocks may have been ineffective or there may have been a failure to sense. Transthoracic defibrillation may be done in the standard manner, but with attempts to keep the paddle 10 cm from the generator, very mild shocks may be felt by the person performing CPR, but these are not painful or dangerous. Immediate deactivation is not a priority but should be considered in the post resuscitation period, when the ICD may not function well.

## KEY CONCEPTS

- Heart failure is among the most frequent conditions resulting in emergency department (ED) visits and hospital admissions, with high morbidity and mortality.
- Heart failure can be divided into heart failure with preserved ejection fraction (HFpEF) and heart failure with reduced ejection fraction (HFrEF), which have similar incidences, morbidities, and mortalities, but different pathophysiologies and response to therapies.
- Neurohormonal mechanisms provide initial compensation for cardiac dysfunction but are ultimately deleterious in heart failure. Chronic therapy to negate these effects is important even in asymptomatic myocardial dysfunction.
- The most common manifestation of acute heart failure is respiratory distress, triggering a differential diagnosis primarily including non-cardiogenic pulmonary edema, exacerbation of chronic obstructive pulmonary disease (COPD) or asthma, pulmonary embolus, pneumonia, tension pneumothorax, cardiac tamponade, and anaphylaxis.
- Recognition of precipitating causes in heart failure allows early understanding of appropriate management issues.
- Biomarkers such as B-type natriuretic peptide (BNP) may improve recognition of heart failure in dyspnea of unclear cause, correlate with severity, help stratify risk, and monitor therapeutic response.
- Distinguishing primary pulmonary disease causing predominantly right-sided heart failure from left ventricular (LV) failure with secondary right-sided dysfunction is clinically challenging, because the physical examination findings and chest radiograph may be similar. Natriuretic peptide levels are much higher in LV failure.
- Most acute heart failure can be managed with upright positioning, supplemental oxygen, non-invasive ventilation, vasodilators, and loop diuretics.
- Hypoperfusing patients with acute cardiogenic pulmonary edema (ACPE) often have unreliable cuff blood pressure (BP) readings and may benefit from invasive arterial monitoring.
- Patients with true poor perfusion may benefit from fluid challenge to restore preload, cardiac output, systemic perfusion, and BP. Careful volume infusion with aliquots of normal saline is appropriate initial resuscitation for the hypoperfusing patient with acute-onset cardiogenic pulmonary edema.
- In hypoperfusing patients who are adequately volume repleted (true cardiogenic shock), norepinephrine is the pressor of choice.
- In chronic heart failure, routine use of beta-blockers, angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs), diuretics including spironolactone, and occasionally digoxin has resulted in sustained symptomatic improvement and reduced 5-year mortality in HFrEF.
- Various electrical therapies, particularly cardiac resynchronization therapy (CRT) and implantable defibrillators, as well as mechanical techniques like implantable left ventricular assist devices (LVADs) and cardiac transplantation add complexity to chronic heart failure management, but improve morbidity and mortality.
- Observation medicine plays an increasing role in reducing costs and admissions in heart failure.

## CHAPTER 71: QUESTIONS &amp; ANSWERS

71.1. In developed countries, what is the most common cause of heart failure?

- A. Acute myocarditis
- B. Atherosclerotic coronary artery disease
- C. Chronic obstructive pulmonary disease (COPD)
- D. Dilated cardiomyopathy
- E. Valvular heart disease

**Answer: B.** In developed countries, atherosclerotic coronary artery disease is the leading cause of heart failure, present in almost 70% of patients in multicenter heart failure trials. Dilated cardiomyopathy is much more common than hypertrophic or restrictive types and is the second most common cause of heart failure. Valvular heart diseases and myocarditis are less common causes of heart failure. COPD, with a prevalence of 20% to 30% in heart failure, frequently obscures its recognition.

71.2. A 54-year-old male with a history of hypertension and diabetes mellitus presents with sudden onset of dyspnea and severe chest pain. His electrocardiogram (ECG) shows 2 to 3 mm of ST-segment elevation in leads  $V_1$  to  $V_4$ . A portable chest radiograph demonstrates evidence of pulmonary edema. He is placed on oxygen and a nitroglycerin drip, and his chest pain resolves while his ECG changes improve. His blood pressure (BP) suddenly drops to 80/54 and his heart rate (HR) increases to 112 beats per minute. Besides stopping the nitroglycerin drip and contacting interventional cardiology, what is the next appropriate therapeutic intervention?

- A. Crystalloid boluses to restore perfusion
- B. Intra-arterial pressure monitoring to confirm hypotension
- C. Lopressor to reduce HR
- D. Norepinephrine for cardiogenic shock
- E. Thrombolytic therapy for ST-elevation myocardial infarction (STEMI)

**Answer: A.** Understanding the pathophysiology here is important. Presumably, this is acute coronary syndrome, probably resulting from left anterior descending coronary artery occlusion. The resultant acute diastolic dysfunction increases left ventricular (LV) filling pressure greatly and leads to flash pulmonary edema with alveolar flooding. This pulmonary edema came from acute displacement of intravascular volume, which is now significantly reduced. Because coronary ischemia often has a stuttering course and nitroglycerin may also improve coronary perfusion through vasodilatory properties, the ischemia and diastolic dysfunction can acutely resolve. Hypotension, if it occurs, is related to intra-vascular volume depletion, and crystalloid volume replacement, done judiciously, is the most appropriate intervention. Lopressor, a beta-blocking agent, would be less helpful here, because cardiac inotropic function needs to be maintained. Norepinephrine is the vasopressor of choice for cardiogenic shock, but in this particular setting, volume resuscitation should be tried first. Although intra-arterial pressure monitoring is appropriate to best understand the true perfusion situation, volume resuscitation is needed promptly. Percutaneous coronary intervention has a survival advantage over thrombolytic therapy in cardiogenic shock resulting from acute myocardial infarction (AMI). With resolution of myocardial ischemia and related improvement in cardiac function, the pulmonary edema will eventually return to the intravascular space. Noninvasive ventilation (NIV) may accelerate this process.

71.3. Which of the following is *not* a common precipitating factor for heart failure?

- A. Acute atrial fibrillation
- B. Acute hypertension
- C. Adrenal insufficiency
- D. Iatrogenic volume overload
- E. Pneumonia

**Answer: C.** Infection, particularly pneumonia resulting from its associated hypoxia and increased work of breathing, is a common precipitating factor for heart failure. Acute atrial fibrillation may reduce ventricular priming (a particular problem with diastolic dysfunction) and also increase heart rate (HR), contributing to heart failure. Volume overload, either because of dietary noncompliance or excessive crystalloid infusion during patient care, can rapidly cause heart failure. Uncontrolled blood pressure (BP) elevations, often resulting from medication noncompliance, may contribute to heart failure exacerbations. Adrenal insufficiency is associated with intravascular volume depletion and more likely to cause hypoperfusion.

- 71.4.** A 63-year-old male presents with an acute exacerbation of chronic heart failure. He admits to moderate alcohol and occasional cocaine use. He is presently intoxicated and slightly agitated. His blood pressure (BP) is 234/124 mm Hg with a heart rate (HR) of 128, respiratory rate of 28, and temperature at 100.4° F (38.0° C), along with oxygen saturation measured by pulse oximetry (SpO<sub>2</sub>) of 95% on room air. He has jugular venous distention; bibasilar rales; a rapid, regular S1 and S2; and 3+ edema in both lower extremities. Which of the following interventions is likely to provide the most benefit?
- A. 100% oxygen by face mask
  - B. Biphase positive airway pressure (BiPAP)
  - C. Furosemide
  - D. Lopressor
  - E. Nitroglycerin

**Answer: E.** Lopressor, a beta-blocking agent, is not usually a drug of choice in *acute* heart failure and may indeed lead to unopposed alpha-agonist effect if cocaine has been recently used, with possible deterioration. The patient's pulse oximetry suggests adequate oxygenation, and supplemental oxygen would provide minimal benefit, whereas hyperoxemia may theoretically increase afterload by its vasoconstrictive effect. Similarly, noninvasive ventilatory support using BiPAP may not be well tolerated in this agitated patient, and although it may help by reducing both preload and afterload, better options exist. Furosemide may be a reasonable intervention, but prompt afterload reduction with nitroglycerin, preferably intravenously, is likely to be the most beneficial treatment for this very hypertensive heart failure patient.

- 71.5.** Each of the following classes of medications has a significant role in the management of chronic heart failure, except:
- A. Angiotensin-converting enzyme (ACE) inhibitors
  - B. Beta-blockers
  - C. Calcium channel blockers
  - D. Diuretics
  - E. Nitrates

**Answer: C.** Beta-blocker therapy increases survival in heart failure, probably through modulation of multiple neurohormonal responses. ACE inhibitors provide the most effective therapy for left ventricular (LV) dysfunction. Diuretics help deal with the decreased ability to excrete excess salt and water in heart failure. Nitrates, by direct vasodilatory effects, improve exercise tolerance and hemodynamics in chronic heart failure. Calcium channel blockers, particularly first-generation ones (verapamil, diltiazem, and nifedipine), do not improve survival in this disease, and there is no compelling evidence that they are useful in chronic heart failure.

- 71.6.** A 47-year-old female presents with severe shortness of breath and palpitations. She has bilateral proptosis; a symmetrically enlarged thyroid gland; inspiratory crackles bilaterally on pulmonary examination; rapid, irregular heart sounds on cardiac examination; and bipedal edema. Her blood pressure (BP) is 220/100 mm Hg with an irregular pulse at 156 beats per minute. What is the initial therapy of choice?
- A. Dexamethasone
  - B. Diltiazem
  - C. Esmolol
  - D. Nesiritide
  - E. Nitroglycerin

**Answer: C.** This patient has acute pulmonary edema and probable atrial fibrillation, with a high output type of heart failure likely due to thyrotoxicosis, presumably caused by Graves' disease. Beta-blockade, here with esmolol, which has a short half-life and can be titrated, is in this particular clinical situation the therapy of choice among these options. Beta-blockade will reduce the elevated thyroid hormone effects on cardiac function, which probably precipitated high output heart failure and atrial fibrillation. Vasodilator therapy with nitroglycerin will not improve the cardiac effects of thyrotoxicosis, and nesiritide has minimal role in the present treatment of heart failure. Diltiazem may reduce ventricular rate but is not the most effective treatment in this clinical situation. Dexamethasone plays a minor role in the treatment of thyrotoxicosis.

## KEY CONCEPTS

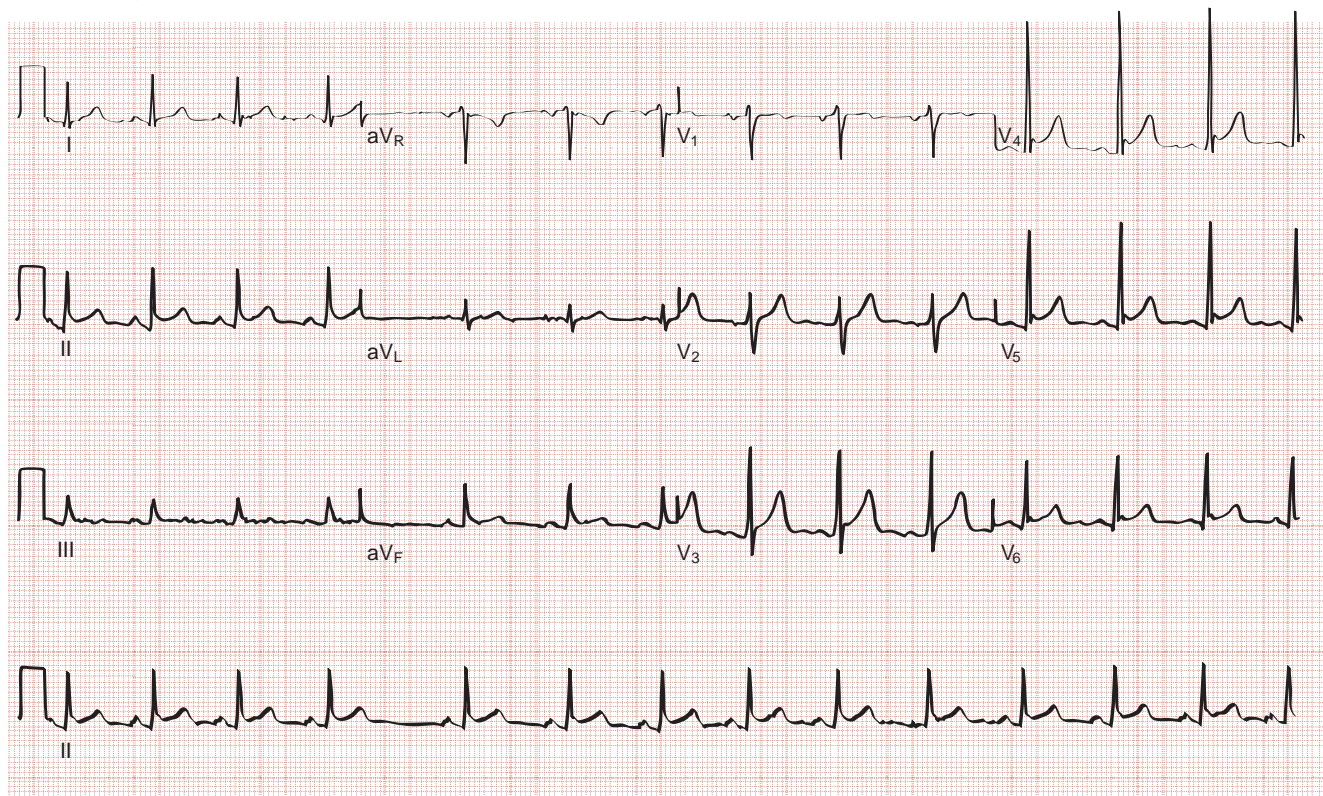
- Pericarditis and myocarditis should be differentiated from acute myocardial infarction (AMI). Acute treatment is with nonsteroidal antiinflammatory drugs (NSAIDs) supplemented with colchicine.
- Cardiac tamponade is suspected in patients with dyspnea, distended neck veins, hypotension, and muffled heart sounds. Diagnosis is by ultrasound. Pericardiocentesis is both diagnostic and therapeutic.
- Myocarditis should be considered in *any* patient with the combination of viral illness symptoms and a new presentation of cardiac disease.
- Patients with newly diagnosed hypertrophic cardiomyopathy (HCM) should avoid strenuous exertion until evaluated by a cardiologist. Beta-blockers are the mainstay of therapy for HCM; nitrates should be avoided.
- Many of the cardiomyopathies have genetic origins. Send patients for cardiology evaluation and genetic testing.

## CHAPTER 72: QUESTIONS &amp; ANSWERS

72.1. A 33-year-old man presents with a 4-hour history of left anterior chest pain associated with mild shortness of breath. He is otherwise healthy except for chronic tobacco use. Vital signs are: blood pressure, 142/92 mm Hg; heart rate, 120 beats per minute; respiratory rate, 24 breaths per minute; temperature, 100.4° F (38.0° C) oral; and oxygen saturation, 97%. Physical examination is remarkable only for tachycardia. The patient's electrocardiogram (ECG) is shown below. Which of the following would be the most appropriate therapy?

- Further decision making after initial troponin evaluation
- Nitroglycerin, aspirin 325 mg *per os* (by mouth) (PO), cardiology consultation
- Nonsteroidal antiinflammatory drugs (NSAIDs) and reassurance
- Reassurance and ibuprofen 800 mg tid for 7 days
- Thrombolysis

**Answer: A.** The ECG shows findings consistent with acute pericarditis. Clinically, diffuse ST elevation is seen in leads I, II, III, aV<sub>L</sub>, aV<sub>F</sub>, and V<sub>2</sub> to V<sub>6</sub>. In contrast to finding an acute myocardial infarction (AMI), ST elevations are concave upward in acute pericarditis rather than convex upward as seen with a myocardial infarction (MI). PR depression is also a frequent finding. As the acute pericarditis resolves, ST changes revert to normal, followed by T wave flattening and later deep symmetrical inversion, which may persist. NSAIDs are the mainstay therapy for uncomplicated pericarditis.





- 72.2. Which of the following statements regarding post-myocardial infarction (MI) pericarditis is true?
- A. Classic pericarditis electrocardiogram (ECG) findings are reliably seen.
  - B. It indicates a greater degree of myocardial damage than those without pericarditis.
  - C. Large pericardial effusions are common.
  - D. The incidence of congestive heart failure (CHF) is unchanged.
  - E. The incidence of dysrhythmias is unchanged.

**Answer: B.** Both dysrhythmias and CHF are more common in patients who experience post-MI pericarditis. Large effusions are uncommon, and classic pericarditis ECG findings are often overshadowed by the changes of the recent or evolving MI.

- 72.3. Which of the following disorders is *least* likely to be associated with pericarditis?
- A. Giant cell arteritis
  - B. Rheumatoid arthritis
  - C. Sjögren's syndrome
  - D. Systemic lupus erythematosus (SLE)
  - E. Takayasu's arteritis

**Answer: E.** Fifty percent of SLE patients have pericarditis discovered at autopsy. Approximately one-third of patients with rheumatoid arthritis and Sjögren's syndrome develop evidence of pericarditis, with the former typically also having rheumatoid nodules and valvular disease. Giant cell arteritis typically demonstrates a granulomatous myocarditis. Takayasu's arteritis is a large cell vasculitis, typically affecting the aorta and/or its major branches. Pericarditis is very uncommon.

- 72.4. A 35-year-old woman presents with progressive dyspnea, chest pain, and cough over 5 days. She has a past history of Hodgkin's lymphoma and is 2 years status postchemotherapy and mediastinal irradiation for malignant adenopathy. She is currently on no medications and does not smoke. Vital signs are: temperature, 100.2° F (37.9° C) oral; heart rate, 120 beats per minute; respiratory rate, 26 breaths per minute; blood pressure, 100/60 mm Hg; and oxygen saturation, 96% on room air. Physical examination is remarkable for 3-cm jugular venous distention at 45 degrees, clear lung fields on auscultation, tachycardia without a friction rub, trace pretibial edema, and weak peripheral pulses that disappear during expiration. Chest radiograph shows an enlarged cardiac silhouette and clear lung fields. What would be the most appropriate initial intervention?
- A. Endotracheal intubation with rapid sequence induction
  - B. Enoxaparin 1 mg/kg intravenously
  - C. Helical computed tomography (CT) scan of the chest
  - D. Isotonic fluid bolus and emergent cardiac ultrasonography
  - E. Methylprednisolone 125 mg intravenously

**Answer: D.** This patient is presenting with pericardial tamponade, presumably malignant because of her history of lymphoma. Radiation pericarditis is also possible, and effusion would be possible in this circumstance. Pulmonary embolus is a consideration but less likely, given the picture of normal oxygen saturation and an enlarged heart. The initial intervention should be fluid loading to maintain venous return and cardiac output, followed by ultrasound confirmation and likely pericardiocentesis. Tracheal intubation is not currently indicated because improvement would be expected after effusion aspiration.

- 72.5. A 44-year-old man complains of swollen legs. He just finished two courses of prednisone for wheezing related to asthma. The first course was prescribed 6 weeks ago in the emergency department (ED), where he was diagnosed with new onset asthma and normal chest radiograph. The second course was prescribed by his family physician 2 weeks ago. The patient denies fever and chest pain and is still mildly short of breath, which is worse at night or with exertion. Examination shows bibasilar rales in his lungs, normal heart sounds, and 1+ edema in both legs up to his knees. What is his diagnosis?
- A. Asthma exacerbation
  - B. Idiopathic dilated cardiomyopathy (DCM)
  - C. Prednisone-induced edema
  - D. Prednisone-induced liver failure
  - E. Renal failure

**Answer: B.** The patient is unlikely to have a new diagnosis of asthma. He most likely had a viral process leading to reactive airway disease initially and a viral myocarditis later. He unfortunately now has a DCM and symptoms of congestive heart failure (CHF). Treatment is supportive.

- 72.6. A 16-year-old male presents in cardiac arrest suffered during a high school football game. He is successfully resuscitated in the emergency department (ED) and admitted to the intensive care unit (ICU). What is the most likely cause of his arrest and what should you tell the family?
- A. Cocaine-induced dysrhythmia: Stop using drugs
  - B. Familial dysrhythmia: Seek cardiology evaluation
  - C. Hypertrophic cardiomyopathy (HCM): Seek genetic testing
  - D. Steroid-induced cardiac damage: Stop steroids and consult cardiology
  - E. Traumatic arrest: Wear more padding

**Answer: C.** HCM is a common cause of cardiac arrest in patients thought to be too young for coronary artery disease. It is a genetic disease with many different clinical expressions. Both the patient and all family members should be screened for HCM. Although screening may not predict future risk of sudden death, treatment and prevention could be considered.



## KEY CONCEPTS

- Many patients seen early in the bacteremic phase of IE lack a murmur and are indistinguishable from those with viremia.
- Patients for whom suspicion of endocarditis is moderate to high require blood cultures, echocardiography, and admission for definitive diagnosis and initiation of empirical therapy.
- Prophylaxis for IE is rarely, if ever, indicated for procedures performed in the ED.
- Acute rheumatic fever is a delayed nonsuppurative complication of streptococcal pharyngitis characterized by arthritis, carditis, chorea, subcutaneous nodules, and erythema marginatum.
- In a patient with severe mitral stenosis, hypovolemia and tachycardia are poorly tolerated. Slow and full are appropriate goals.
- In patients with critical aortic stenosis, excessive preload reduction with vasodilators and diuretics is to be avoided.
- In patients with acute aortic insufficiency, classic physical findings may be absent. Medical stabilization entails the cautious use of vasodilators and diuretics. Intraaortic balloon counterpulsation is contraindicated.
- Complications of prosthetic heart valves range from structural failure and thrombosis to systemic embolization, hemolysis, and endocarditis.

## CHAPTER 73: QUESTIONS &amp; ANSWERS

73.1. What is the most common manifestation of acute rheumatic fever (ARF)?

- A. Carditis
- B. Chorea
- C. Erythema marginatum
- D. Polyarthritis
- E. Subcutaneous nodules

**Answer: D.** Arthritis occurs early in the course of ARF. The knees, ankles, elbows, and wrists are commonly affected, and pain can be out of proportion to physical findings. Cardiac manifestations are subtle and may reflect endocarditis, myocarditis, or pericarditis. Chorea, nodules, and erythema marginatum are rare. Chorea is typically a late finding.

73.2. A 49-year-old woman presents with progressive dyspnea on exertion and orthopnea. Vital signs are temperature 36.7°C (98.1°F; oral), heart rate, 110 beats/min, blood pressure, 135/80 mm Hg, respiratory rate, 22 breaths/min, and oxygen (O<sub>2</sub>) saturation, 97% on room air. The physical examination is remarkable for clear lung fields and an irregularly irregular rhythm with a 4/6 diastolic

murmur in the left anterior axillary line. She has no peripheral edema. Which of the following would be appropriate hemodynamic management of her cardiac pathophysiology?

- A. Aggressive diuresis
- B.  $\beta_1$ -Agonist to increase chronotropy
- C. Beta blockade
- D. Selective arterial vasodilator
- E. Selective venodilator

**Answer: C.** This patient has a picture consistent with atrial fibrillation and mitral stenosis. The apical diastolic murmur and left atrial enlargement, along with progressive dyspnea, all support the diagnosis. Tachycardia is poorly tolerated because of the need for higher left atrial pressures and a longer time during diastole to perfuse across the stenotic valve. Slow and full would be appropriate guidelines. Both diuresis and a venodilator might decrease venous return. Any agent producing tachycardia would decrease diastole time and left ventricular preload. An arterial vasodilator would have little effect, given the normal blood pressure and the fact that systemic vascular dilation would not be seen at the mitral valve level as long as the aortic valve was competent.

## KEY CONCEPTS

- Elevated blood pressure with or without associated symptoms is exceedingly common in the ED.
- A true hypertensive emergency is defined by the presence of acute target organ damage and is distinct from other clinical presentations.
- An organ system–based approach to the evaluation and management of patients with elevated blood pressure can optimize decision making while ensuring timely delivery of antihypertensive therapy to those who need it.
- For patients who lack acute TOD, immediate antihypertensive therapy is not needed. However, emergency clinicians can play an important role in the care of this group, providing screening and ongoing surveillance to prevent secondary complications of this disease.
- Administration of a short-acting, potent antihypertensive agent such as clonidine, hydralazine, or nifedipine simply to improve BP values may be harmful and is not recommended in the ED.

## CHAPTER 74: QUESTIONS &amp; ANSWERS

**74.1.** An 85-year-old man presents with acute onset of right-sided weakness that began 1 hour before arrival. His family states that he was recently diagnosed with dementia and has refused to take any of his medications for more than 1 week but had otherwise been relatively healthy. Emergency medical services (EMS) reports a prehospital blood pressure of 240/110 mm Hg. On examination, the patient has clear evidence of an acute stroke with severe deficit (National Institutes of Health [NIH] Stroke Scale = 24), but his gag reflex is intact. His initial blood pressure is 230/110 mm Hg. A head computed tomography (CT) scan shows diffuse white matter ischemic disease but no evidence of acute infarct or hemorrhage. The most appropriate next step is which of the following?

- Contact neurosurgery for intracranial pressure monitoring.
- Give a dose of tissue plasminogen activator (tPA) immediately.
- Give sublingual nifedipine.
- Intubate and paralyze the patient.
- Repeat the blood pressure and, if 185/110 mm Hg or higher, start a nicardipine infusion at 5 mg/hr.

**Answer: E.** Despite his advanced age, this is a relatively high-functioning individual with acute onset of a severe stroke. He is within the time window for administration of tPA, but his blood pressure is excessively elevated. According to the American Heart Association/American Stroke Association guidelines, efforts should be made to reduce his blood pressure to less than 185/110 mm Hg before tPA administration. Other agents, such as labetalol, would also be appropriate to use.

**74.2.** A 27-year-old woman presents with lower back pain for 1 week. She recently moved into the community and has been busy unpacking and moving furniture. She denies any neurologic symptoms and has no medical history. Her triage blood pressure is 170/110 mm Hg, but vital signs are otherwise normal. With the exception of appreciable muscle spasm in her lower back, the physical examination is normal. You give her 10 mg of diazepam and observe her for 1 hour. She is feeling better but her blood pressure is still elevated, at 165/90 mm Hg. At this point you should do which of the following?

- Give her 0.2 mg of clonidine.
- Ignore the blood pressure and discharge her without follow-up.
- Order a renal ultrasound scan.
- Order a 24-hour urine metanephrine and normetanephrine test.
- Take a more extensive history to see if she is taking oral contraceptives.

**Answer: E.** This patient's blood pressure elevation is clearly not a reaction to her pain, and some further questioning is needed to identify a potential cause. In young women, oral contraceptive agents are a treatable cause of hypertension and should be considered when elevated blood pressure is encountered in these patients. Of note, the likelihood of contraceptive-related hypertension increases with the duration of use. It would not be unreasonable to discharge the patient without further exploring the potential cause of her elevated blood pressure, provided some

provision of follow-up was sought. The clinical picture is inconsistent with renal artery stenosis or pheochromocytoma, and an evaluation for these conditions would be inappropriate at this point.

**74.3.** A 50-year-old man complains of dull chest pain that began 4 hours before arrival. The patient states he awoke this morning feeling well and that the pain began while shoveling his driveway. He has a 20-year history of hypertension and diabetes but has always been compliant with his medications, which include metformin, Norvasc, and Diovan. His initial blood pressure is 215/120 mm Hg, and his heart rate is 100 beats/min. On examination, his lungs are clear, heart sounds are normal, pulses are bounding and symmetric, and there are no neurologic deficits. An electrocardiogram shows nonspecific T wave inversions in the lateral leads, with no evidence of ST segment elevation or depression and normal intervals. The serum troponin level is elevated. Which of the following is the most likely explanation for his clinical presentation?

- He has a ruptured dissecting aortic aneurysm that is leaking blood into the retroperitoneal space.
- He is suffering from a massive pulmonary embolism.
- He strained an intercostal muscle while shoveling.
- He is suffering from subendocardial ischemia triggered by a cycle of increased afterload that began while he was shoveling.
- His right coronary artery is 100% occluded.

**Answer: D.** Increased afterload can be triggered by exertional activation of the sympathetic nervous system. In the presence of long-standing hypertension, ventricular and aortic stiffness are likely to develop, increasing the potential for afterload-mediated effects on the heart. When suddenly faced with increased resistance, the left ventricular pressure may rise, leading to intrinsic compression of subendocardial myocytes and ischemia. Coupled with earlier transmission of the reflected arterial wave form, the diastolic coronary filling time may also be diminished, producing a clinical picture of acute coronary syndrome. He may also have a coronary artery lesion on which this is superimposed but, as described, the likelihood of his clinical presentation being caused by a complete right coronary occlusion is quite low.

**74.4.** Which of the following funduscopic findings would be the earliest indicator of acute hypertensive retinopathy in a comatose patient whose blood pressure is 260/140 mm Hg?

- Copper and silver wiring appearance to the retinal arterioles
- Cotton wool spots
- Diffuse atrioventricular (AV) nicking
- Focal intraretinal periarteriolar transudates
- Retinal hemorrhages

**Answer: D.** Focal intraretinal periarteriolar transudates are the first abnormality to appear with acute hypertensive retinopathy, preceding all other findings, including cotton wool spots and disk edema. Other findings that are listed may also be seen, but they are indicative of chronic, not acute, retinal involvement. It is important to remember that acute retinal abnormalities may be absent in hypertensive emergency patients and, although fundus copy is an important tool, the diagnosis should be based primarily on the results of the clinical examination.

## KEY CONCEPTS

- Most patients with aortic dissection have chest pain, typically of sudden onset, sharp, and migratory. Chest pain associated with neurologic symptoms or syncope should increase the likelihood of aortic disease.
- Physical examination findings may include pulse deficit, aortic insufficiency murmur, and neurologic findings, but often the physical examination is not diagnostic, and imaging is essential to establish or exclude the diagnosis of dissection.
- Of the confirmatory tests, CT aortography is recommended. Transesophageal echocardiography is also an excellent test and can be used when CT is not available or for patients with contrast allergy, renal insufficiency, or critical illness that precludes CT scanning.
- Patients with type A aortic dissection require emergent cardiovascular surgery consultation as well as ED management of blood pressure and heart rate prior to intraoperative repair.
- Patients with acute type B dissections also require stabilization of the blood pressure and pulse to prevent progression of symptoms and frequently require admission as inpatients for further monitoring. Long-term treatment decisions of type B dissections should be based on the patient's current symptoms, input from the cardiovascular surgical team, and discussion with the patient regarding risks and benefits of therapy.

## CHAPTER 75: QUESTIONS &amp; ANSWERS

**75.1.** Which valvular abnormality is associated with aortic dissection?

- A. Aortic regurgitation
- B. Aortic stenosis
- C. Mitral regurgitation
- D. Mitral stenosis

**Answer: A.** Aortic regurgitation occurs in up to 32% of patients and is more common with type A dissections. A bicuspid aortic valve is found in 14% of patients with dissections and may predispose to dissection by disrupting the blood flow.

**75.2.** A 67-year-old man presents with ripping substernal chest pain. Physical examination is remarkable for blood pressure, 180/110 mm Hg, pulse, 110 beats/min, respiratory rate, 18 breaths/min, and temperature, 37°C (98.6°F). The electrocardiogram (ECG) is unremarkable. Which of the following diagnostic studies is the best test to rule out aortic dissection?

- A. Chest radiograph
- B. Computed tomography (CT) aortography
- C. Magnetic resonance imaging (MRI)
- D. Transthoracic echocardiography

**Answer: B.** CT aortography is a reliable test with the best combination of high sensitivity and specificity for diagnosing aortic dissection. A chest radiograph may be a fast screening test, but 12% will be falsely normal. MRI is more sensitive but is not always available and is unsuitable for unstable patients.

**75.3.** A 59-year-old man presents with sharp chest pain.

Physical examination is remarkable for blood pressure 192/116 mm Hg, pulse, 116 beats/min, respiratory rate, 16 breaths/min, temperature, 37.2°C (98.9°F). Chest auscultation reveals a diastolic murmur. Which of the following medications is the best initial treatment choice for his condition?

- A. Dobutamine
- B. Esmolol
- C. Nifedipine
- D. Phentolamine

**Answer: B.** Esmolol and labetalol are titratable, short-acting beta blockers that can be used as monotherapy for hemodynamic control in aortic dissection. These can be started quickly to control blood pressure but, more importantly, to decrease the rate of pressure change.

**75.4.** Which of the following is the most common sign or symptom of a patient with aortic dissection?

- A. Aortic insufficiency murmur
- B. Chest pain
- C. Pulse deficit
- D. Syncope

**Answer: B.** Pain is the most common presenting complaint, affecting more than 90% of patients. Syncope, a pulse deficit, and aortic insufficiency murmur are all important to elicit and affect the outcome.

## KEY CONCEPTS

- A ruptured AAA should be considered in any patient older than 50 years with otherwise unexplained abdominal or back pain. The complete triad of pain, hypotension, and a pulsatile mass may not be present.
- In the patient with an AAA and acute symptoms, rupture is imminent or has already occurred.
- The patient with a ruptured AAA who is initially hemodynamically stable can suddenly deteriorate at any time.
- The risk of rupture increases dramatically with increased aneurysm size, and most ruptured AAAs have diameters greater than 5 cm.
- Bedside ultrasound may be used to document an AAA or free fluid and assist in rapid diagnosis of a ruptured AAA.
- The abdominal CT scan is the diagnostic test of choice in the evaluation of the stable patient with suspected ruptured AAA; intravenous contrast is not essential in emergency situations.
- The patient who has had endovascular repair of an AAA remains at risk for aneurysm rupture.

## CHAPTER 76: QUESTIONS &amp; ANSWERS

**76.1.** What is the most common complication from abdominal aortic aneurysms (AAAs)?

- A. Aortoenteric fistula (AEF)
- B. Mesenteric ischemia
- C. Renal artery compromise
- D. Rupture
- E. Ureteral obstruction

**Answer: D.** Rupture is by far the most common complication of AAAs. Rupture typically occurs into the retroperitoneum, allowing potential tamponade of the rupture site. Only 10% to 30% have free intraperitoneal rupture, which is often rapidly fatal.

**76.2.** A 67-year-old man presents with the acute onset of pain and decreased temperature in his right foot. Symptoms began 2 hours ago at rest. Past medical history is significant for tobacco use, hypertension, and hyperlipidemia. The physical examination reveals moderate distress due to foot pain and is otherwise normal except for the extremity examination, which shows symmetrical and intact distal pulses but pale and patchy skin mottling of the right leg with a cool, bluish right foot. The foot is not swollen. What of the following is the best explanation for these findings?

- A. Abdominal aortic microemboli
- B. Abdominal aortic pseudoaneurysm
- C. Acute thrombosis of the femoral and popliteal veins
- D. Acute thrombosis of the iliac veins
- E. Popliteal artery thrombosis

**Answer: A.** Microemboli consist of cholesterol crystals or small clot fragments that may shower distally. The combination of normal pedal pulses and cool cyanotic and painful toes is called the *blue toe syndrome* and suggests a proximal source of microemboli. The source may be the heart or a diseased aorta, and an aneurysm may or may not be found. Venous thrombosis would cause distal swelling, and pedal pulses would not be normal with popliteal artery thrombosis.

**76.3.** A 79-year-old man presents with syncope. The episode occurred 1 hour before arrival, without preceding symptoms. The family reports a past history of peptic ulcer disease controlled with medications and a surgical repair of an abdominal aortic aneurysm (AAA) 15 years ago. Physical examination reveals a pale man with a heart rate of 115 beats per minute, blood pressure of 83/54 mm Hg, and respiratory rate of 22 breaths per minute. Other pertinent findings are an abdominal examination without palpable masses and gross melena on rectal examination. Concurrent with volume resuscitation, what would be the most appropriate next step?

- A. Addition of albumin to crystalloid infusion
- B. Computed tomography (CT) scan of the abdomen with contrast enhancement
- C. Immediate gastrointestinal service consultation for upper endoscopy
- D. Immediate vascular surgical consultation

**Answer: D.** The presence of gastrointestinal bleeding with a history of aortic surgery or current evidence of an AAA is an aortoenteric fistula (AEF) until proven otherwise. The most common site of vascular bowel erosion is the third or fourth portion of the duodenum, causing hematemesis or melena. The initial bleeding may be minor, followed days to weeks later by massive bleeding. Surgical intervention is required. Although endoscopy or CT scanning might help with diagnosis, this patient is not stable enough to undergo endoscopy or for transfer to the scanner. Hypotensive patients may have to be taken to the operating room on the basis of a strong clinical presumption.

**76.4.** What is the strongest predictor of mortality in patients with a ruptured abdominal aortic aneurysm (AAA)?

- A. Age older than 70 years old
- B. Anemia on ED arrival
- C. Hyperglycemia
- D. Hypotension
- E. Presentation more than 12 hours after symptom onset

**Answer: D.** Preoperative hypotension is the strongest predictor of mortality. Paradoxically, there are few data guiding volume resuscitation, fluid choices, and target blood pressures. Clearly, rapid operative or endovascular surgery is most important. Crystalloid resuscitation before repair might cause dilutional coagulopathy and clot dislodgement by raising the intravascular pressure. Judicious volume resuscitation with early use of blood products and a target systolic pressure of 80 to 100 mm Hg is probably reasonable.

**76.5.** A 67-year-old man presents with a several-day history of intermittent periumbilical abdominal pain. Physical examination and vital signs are unremarkable except for supraumbilical tenderness. Hemoglobin is 12 g/dL. Contrast-enhanced computed tomography (CT) scan of the abdomen details a 4.2-cm infrarenal abdominal aortic aneurysm (AAA) with an apparent old contained rupture with no obvious new or acute blood. All of his discomfort is relieved by a single dose of morphine sulfate. Which of the following would be the most appropriate course of action?

- A. Surgical consultation
- B. Internal medicine admission for observation and intravenous antibiotics
- C. Gastrointestinal consultation for early follow-up and upper or lower endoscopy
- D. Emergency department (ED) observation for 6 to 8 hours with serial abdominal examinations
- E. Vascular surgery clinic follow-up in 1 or 2 days

**Answer: A.** Watchful waiting is indicated only for asymptomatic aneurysms, regardless of the size (up to 5.5 cm). The majority of “stable” AAAs are neither painful nor tender, and the presence of both in this patient suggests imminent rupture. Although the CT scan did not detect acute blood, the safest course of action would be surgical consultation, with early or imminent rupture as the presumed source of this patient’s symptoms.

- 76.6. Which of the following is most common in the patient with an intact (nonruptured) 6-cm abdominal aortic aneurysm (AAA)?
- A. Abdominal pain
  - B. Absence of any symptoms
  - C. Back pain
  - D. Lower extremity pain
  - E. Sensation of abdominal distention

**Answer: B.** Most intact AAAs are asymptomatic. They may be discovered incidentally on physical examination or a radiologic study done for other reasons or may be found in an ultrasonographic aneurysm screening program. Pain in the abdomen or back does not usually develop until the aneurysm ruptures. Perfusion of the lower extremities is usually normal in patients with AAAs.

- 76.7. A 67-year-old man presents with a 1-week history of mild epigastric pain. On examination, he has a blood pressure of 150/100 mm Hg; the remainder of his vital signs are normal. He has no abdominal tenderness, guarding, or palpable masses. His hemoglobin is 14.0 g/dL. A bedside ultrasound examination reveals a 4.0-cm abdominal aortic aneurysm (AAA) without evidence of rupture. Which of the following is the most appropriate next step?
- A. Arrange immediate operative intervention
  - B. Lower blood pressure with intravenous therapy
  - C. Obtain abdominal computed tomography (CT) scan
  - D. Refer for outpatient surgical evaluation

**Answer: C.** The patient has abdominal pain and an AAA, and it is unclear whether the pain is caused by aneurysm rupture; there is no indication for immediate surgery, which has a higher mortality rate than that of elective repair. However, the possibility of rupture makes outpatient referral inappropriate without further investigation. Ultrasonography cannot reliably exclude aneurysm rupture; therefore, a CT scan is indicated. If the CT scan shows no evidence of rupture, a decision about the next step should be made in consultation with a surgeon. Unlike the situation with aortic dissection (see Chapter 75), there is no evidence that lowering a mildly or moderately elevated blood pressure is beneficial in the patient with an intact or ruptured AAA.



## KEY CONCEPTS

- Acute arterial occlusion is a limb-threatening emergency requiring early heparinization and Fogarty catheter embolectomy. The clinical diagnosis is based on some variant of the five Ps: pain, pallor, pulselessness, paresthesias, and paralysis. Confirmatory tests are unnecessary and increase the limb's ischemic status.
- Atheroembolism (blue toe syndrome) is associated with cool, painful cyanotic toes in the presence of palpable distal pulses. A proximal source should be localized, most often an atherosclerotic aneurysm in the aorta or the iliac, femoral, or popliteal artery.
- Popliteal aneurysms are bilateral in 60% of patients and often coexist with an abdominal aortic aneurysm.
- The classic Raynaud attack is triphasic: the fingers become white, blue, and then red. Raynaud's disease has no detectable underlying cause and usually has a benign course. Raynaud's phenomenon has an underlying disorder, usually connective tissue disease.
- The only reliable clinical test for detection of thoracic outlet syndrome is the elevated arm stress test (EAST).
- Partial arterial lacerations continue to bleed, resulting in an expanding hematoma. Complete arterial transections initially have only moderate bleeding but can result in delayed hemorrhage. Blunt arterial injury may produce intimal disruption resulting in dissection, thrombosis, and/or obstruction. Arterial vasospasm can accompany injuries adjacent to the blood vessel but spontaneous resolution always occurs in the absence of arterial disruption or intimal injury.
- Aneurysms and arterial stenoses are characterized by a systolic murmur. Pseudoaneurysms, associated with prior surgical or trauma sites, are characterized by a loud systolic and possibly a separate, faint diastolic murmur. Arteriovenous fistulae are characterized by a harsh "to and fro" murmur associated with a palpable thrill.
- Intra-arterial injection of illicit drugs into the brachial or radial artery is associated with immediate onset of a severe, burning pain, and emergency department presentation with patchy blue-purple skin discoloration. Because patients tend to seek attention early and may withhold information about the use of intravenous drugs, identifying the site of injection is helpful in confirming this syndrome, which can be associated with persistent ischemia and tissue loss.

## CHAPTER 77: QUESTIONS &amp; ANSWERS

77.1. Where do most arterial emboli originate?

- A. Abdominal aorta
- B. Femoral artery
- C. Left ventricle
- D. Left atrium
- E. Thoracic aorta

**Answer: C.** Eighty-five percent of arterial emboli originate in the heart. Of these, left ventricular thrombus formation after myocardial infarction (MI) accounts for 60% to 70%. Atrial thrombi account for only 5% to 10% of all peripheral arterial emboli.

77.2. What is the most frequent site of acute arterial embolic occlusion?

- A. Carotid artery
- B. Common femoral artery
- C. Mesenteric artery
- D. Popliteal artery
- E. Renal artery

**Answer: B.** The bifurcation of the common femoral artery accounts for 35% to 50% of acute arterial occlusion due to arterial embolism. Embolic occlusion most often occurs at major arterial bifurcations because of the sudden change in vessel diameter at these locations.

77.3. A 63-year-old male presents with acute onset of left leg pain while walking. He describes it as a shock-like sensation that made his knee buckle. Past history is remarkable for hypertension, diabetes (diet controlled), tobacco use, and a recent lateral wall myocardial infarction. Current medications are aspirin, metoprolol, and lisinopril. Vital signs are: temperature, 37.0°C oral; heart rate, 98 beats per minute; blood pressure, 160/105 mm Hg; respiratory rate, 20 breaths per minute; and oxygen (O<sub>2</sub>) saturation, 96%. Physical examination is remarkable for left lower extremity pallor with decreased light touch sensation, nonpalpable left foot pulses, and minimal capillary refill. What would be the most appropriate next step in the diagnosis and management of this patient?

- A. Abdominal ultrasonography
- B. Arteriogram
- C. Serum lactate level
- D. Thoracolumbar magnetic resonance imaging (MRI) scan
- E. Vascular surgery consultation

**Answer: E.** This patient has acute limb ischemia from an acute arterial embolus, most likely originating from his left ventricle secondary to a recent myocardial infarction. Loss of light touch sensation on physical examination indicates jeopardized tissue viability, requiring immediate vascular surgery consultation for emergent Fogarty catheter embolectomy. Reliable diagnosis of an acute arterial embolism can almost always be made by history and physical examination alone. Any additional diagnostic evaluation constitutes an unnecessary delay. Serum lactate level, abdominal ultrasonography, and thoracolumbar magnetic resonance imaging (MRI) scan would not provide useful information. An arteriogram before going to the operating room is an unnecessary delay and may further exacerbate limb ischemia.

77.4. A supine patient is asked to raise his foot 12 inches above the estimated level of the right atrium and dorsiflex the foot five or six times. He is then brought to a sitting position with his feet hanging. In the absence of severe advanced ischemia, venous filling of the foot should return in less than how many seconds?

- A. 1
- B. 5
- C. 10
- D. 15
- E. 20

**Answer: E.** This bedside test is Buerger's sign and can provide reliable evidence of advanced ischemia. In the absence of severe advanced ischemia, the lower extremity veins should fill within 20 seconds after being placed in the dependent position.

77.5. A 73-year-old man presents with acute onset of right lower extremity pain. He has a long history of tobacco use, hypertension, and a several year history of moderate calf claudication at 50 yards walking. Physical examination reveals signs of chronic atherosclerotic occlusive disease of the bilateral lower extremities, including muscular atrophy, loss of hair over the toes and feet, and thickening of the toenails. Examination of the distal right lower extremity reveals pallor, absent popliteal and foot pulses, and decreased sensation to light touch of the right foot. The cardiac examination is unremarkable, and the 12-lead electrocardiogram (ECG) reveals only normal sinus rhythm. Based on the most likely diagnosis, what is the most appropriate definitive therapy?

- A. Acute hyperbaric oxygen therapy
- B. Arteriogram to determine the presence of embolus versus in situ thrombosis
- C. Intra-arterial thrombolysis
- D. Surgical referral for Fogarty catheter embolectomy
- E. Surgical referral for Fogarty catheter embolectomy with vascular bypass grafting

**Answer: E.** This patient has a history and physical examination consistent with long-standing peripheral atherosclerotic occlusive disease, no evidence of a proximal source for embolism, but acute onset of ischemic symptoms and loss of light touch in the affected extremity. The most likely diagnosis is a large, in-situ thrombosis precipitating acute limb-threatening ischemia. When limb-threatening ischemia is present, emergent surgical referral for Fogarty catheter embolectomy is indicated, whether caused by acute in-situ thrombosis or embolus. With limb-threatening ischemia caused by in-situ thrombosis, simple Fogarty catheter embolectomy is insufficient and usually requires additional bypass grafting. Acute hyperbaric oxygen therapy has no role in the treatment of limb-threatening ischemia due to in-situ thrombosis or embolism. An arteriogram to determine the presence of embolus versus in-situ thrombosis is unwarranted, represents an unnecessary delay, and may further exacerbate ischemia. Intra-arterial thrombolysis takes 6 to 72 hours to work and is contraindicated in cases of limb-threatening ischemia.

**77.6.** What percentage of patients presenting with arteriosclerosis obliterans are younger than 50 years old?

- A. 1%
- B. 5%
- C. 10%
- D. 20%
- E. 40%

**Answer: D.** Peripheral arteriovascular disease can occur in younger patients. Nineteen percent of patients presenting with atherosclerosis obliterans are between the ages of 30 and 50 years old. Of all arteriosclerosis patients, 33% have coexistent coronary artery disease, and 70% to 90% are smokers. The non-smokers have other risk factors including significant hypertension and hyperlipidemia.

**77.7.** A 49-year-old woman presents with severe left ankle pain. She describes fairly sudden development of a left lateral malleolus hemorrhagic blister that transitioned to a painful superficial ulcer over 48 hours. She has no prior history of extremity ulcers, and her only significant past medical history is hypertension. She has a long-standing history of noncompliance with her hypertensive medications and smokes two packs of cigarettes per day. She has no history of myalgias, joint pain, fever, or systemic symptoms. Vital signs are: temperature, 36°C oral; heart rate, 90 beats per minute; blood pressure, 210/125 mm Hg; respiratory rate, 20 breaths per minute; and O<sub>2</sub> saturation, 96%. Physical examination reveals a thin black female in distress because of pain. Cardiopulmonary examination is unremarkable. Abdominal, neurologic, and extremity examinations are likewise unremarkable except for a well-demarcated, shallow 4 × 3 cm ulcer over the left lateral malleolus. There is mild erythema but no evidence of active infection. Distal pulses and capillary refill are normal. What would be the most appropriate intervention?

- A. Analgesics and admission for vasculitis evaluation
- B. Surgical consultation for possible embolectomy
- C. Wound care and blood pressure control
- D. Wound care and tapering dose of prednisone
- E. Venous Doppler scans and surgical consultation for possible skin grafting

**Answer: C.** This patient has a hypertensive ulcer, which is the most painful of lower extremity ulcers. They typically occur over the lateral malleolus, as opposed to venous stasis ulcers, which are more common anteriorly and medially. Ischemic arterial ulcers are more common distally over the digits. Although vasculitis or a collagen vascular disease are possible, the lack of any other systemic symptoms or prodrome argue against this.

## KEY CONCEPTS

- Deep vein thrombosis often presents as a nonspecific crampy sensation in the upper or lower extremity without obvious swelling.
- An ELISA or immunoturbidimetric D-dimer concentration less than 500 ng/mL can exclude DVT in patients with a low pretest probability (PTP).
- A negative three-point ultrasound, together with a negative quantitative D-dimer test result, excludes DVT with any PTP.
- A negative three-point ultrasound in a patient with a moderate or high PTP for DVT should have additional testing, including a D-dimer test or repeat venous ultrasound within 3 to 7 days.
- An enzyme-linked immunosorbent assay (ELISA) or immunoturbidimetric D-dimer concentration less than 500 ng/mL can rule out PE non-high PTP patients, including all pregnant patients.
- A patient at a low PTP may have the diagnosis of DVT effectively excluded by a negative three-point venous duplex ultrasound performed by a qualified emergency clinician or radiologist.
- A single, whole-leg ultrasound excludes DVT in all pretest probabilities.
- When duplex ultrasound is not available, patients with a moderate to high PTP for DVT should receive empirical LMW heparin, oral apixaban, or rivaroxaban while awaiting the availability of ultrasound imaging; patients with a low PTP, or moderate to high PTP with a negative D-dimer, do not need empirical anticoagulation while they wait for diagnostic imaging.
- Patients at a low or moderate PTP for PE should have a D-dimer test done prior to performing pulmonary vascular imaging; PE can be ruled out in non-high PTP, with a D-dimer adjusted for age according to this formula:  $\text{age} \times 10 \text{ ng/mL}$ .
- A patient with a PTP less than 2% need not be tested for PE.
- Patients with PE and low risk according to the Hestia criteria (see [Box 78.1](#)) can be treated at home, provided they have adequate follow-up.
- Patients with PE and arterial hypotension (systolic blood pressure < 90 mm Hg) should receive systemic fibrinolysis unless they have a contraindication to fibrinolysis.

## CHAPTER 78: QUESTIONS &amp; ANSWERS

- 78.1.** Which of the following statements concerning the D-dimer protein level is most true?
- A. It is derived from the enzymatic breakdown of thrombin.
  - B. It is elevated in patients with acute febrile illness.
  - C. The concentration is higher in smokers but unaffected by advancing age.
  - D. The concentration is proportional to the size of the clot.
  - E. The serum half-life is 48 to 60 hours, making it sensitive for older clots.

**Answer: D.** The D-dimer concentration varies directly with clot burden. It is derived from the enzymatic breakdown of fibrin, with a serum half-life of 8 hours, making it less sensitive for older, more mature clots. Levels are not higher in smokers but may be elevated with advanced age and immobility. It is not elevated by febrile illness.

- 78.2.** What is the sensitivity of venous duplex ultrasonography for detecting a proximal DVT?
- A. 80%
  - B. 85%
  - C. 90%
  - D. 95%
  - E. 100%

**Answer: D.** The sensitivity of a single scan is 95%. Thus, 5% are missed.

- 78.3.** A 29-year-old woman presents with onset of left calf pain and mild swelling over a 24-hour period. She is 26 weeks pregnant, with no other medical problems and no other symptoms. The D-dimer level is 845 ng/mL. Lower extremity duplex ultrasonography is negative. What would be the most appropriate course of action?
- A. Contrast CT scanning of the chest
  - B. Empirical anticoagulation
  - C. Repeat ultrasound in 2 or 3 days
  - D. Repeat ultrasound in 24 hours
  - E. V/Q scan of the chest

**Answer: C.** In moderate- to high-risk patients with an elevated D-dimer level, a single ultrasound may be insufficient. A repeat study in 2 to 7 days is often sufficient to confirm the diagnosis. The lack of pulmonary symptoms precludes the need for lung and embolus evaluation at this time. During pregnancy, there is a progressive rise in baseline D-dimer concentration; thus, a normal value is useful but an elevated level is of no discriminatory value.

- 78.4.** A 43-year-old woman presents with acute pain and swelling of her right saphenous vein. Symptoms have occurred over 48 hours. She does not smoke and has no significant past medical history. Vital signs are unremarkable, and the physical examination is also unremarkable, except for isolated swelling, erythema, tenderness, and increased firmness along the track of the right saphenous vein from the malleolus to 4 cm below the tibial plateau. There is no calf or thigh swelling or tenderness. Which of the following would be appropriate management?
- A. Nonsteroidal antiinflammatory drugs (NSAIDs) and compression stockings
  - B. Antistaphylococcal antibiotics and antiinflammatory agents
  - C. Antistaphylococcal antibiotics and elevation for 24 to 48 hours
  - D. Systemic anticoagulation
  - E. Ultrasonography to rule out DVT, then antiinflammatory agents and compression stockings

**Answer: E.** Many patients with superficial thrombophlebitis have a synchronous DVT. Once ruled out, treatment is symptomatic, with NSAIDs and compression stockings. Ambulation is encouraged. Routine anticoagulation is not indicated for superficial thrombophlebitis.

- 78.5.** A 46-year-old woman presents with pain and swelling of the right calf. She has a history of tobacco use, emphysema, and hypertension. Medications are albuterol inhaler, lisinopril, 20 mg/day, and oral contraceptives. She denies pulmonary or cardiac symptoms. Vital signs and the physical examination are unremarkable except for pain and tenderness to palpation, with minimal swelling of the right calf. Doppler ultrasonography reveals an isolated calf thrombosis. What is the appropriate management?
- A. Aspirin therapy with repeat Doppler in 2 to 7 days
  - B. Intravenous fibrinolysis with tenecteplase
  - C. Nonsteroidal anti inflammatory agents and compression stockings
  - D. Reassurance
  - E. Systemic anticoagulation

**Answer: E.** Approximately 25% of isolated calf DVTs propagate proximally. Serial Dopplers as surveillance for proximal propagation may be acceptable in healthy ambulatory patients, but full anticoagulation, as for DVT, would be the safest course of action for this patient.

- 78.6.** Which of the following statements concerning upper extremity DVTs is true?
- A.** After appropriate treatment, it is rare for symptoms to persist long term after upper extremity DVT.
  - B.** Anticoagulation is not always necessary in upper extremity DVT.
  - C.** If present, indwelling catheter removal is required for successful DVT treatment.
  - D.** Other than catheter-related cases, most occur in patients who are young and healthy.
  - E.** The rate of pulmonary embolus from axillary vein DVT is lower than that from the femoral vein.

**Answer: D.** So-called effort thrombosis is often seen in healthy patients after vigorous exercise. Many of these are later found to have anatomic abnormalities relating to the subclavian and axillary vein. Approximately 50% of upper extremity DVTs are related to indwelling catheters. Catheter removal is not always mandatory. Appropriate treatment for upper extremity DVT includes full anticoagulation and is sometimes accompanied by fibrinolysis or thrombectomy. The incidence of pulmonary embolus is the same as for femoral DVTs. Many patients remain symptomatic, with ongoing arm pain and swelling, despite appropriate treatment.

- 78.7.** In a young healthy patient, what percentage of the cross-sectional area of the pulmonary vascular bed can be acutely occluded with only minimal symptoms?
- A.** 10%
  - B.** 20%
  - C.** 30%
  - D.** 40%
  - E.** 50%

**Answer: C.** Again, this assumes a patient with full cardiopulmonary reserve and no preexisting disease.

- 78.8.** What percentage of patients with pulmonary embolus may present with a normal (98%–100%) pulse oximetry reading on room air?
- A.** 5%
  - B.** 10%
  - C.** 15%
  - D.** 20%
  - E.** 25%

**Answer: B.** A low oxygen saturation (<95%) increases the probability of pulmonary embolus, but a normal oxygen saturation should not dissuade one from the diagnosis.

- 78.9.** What percentage of patients diagnosed with pulmonary embolus have no apparent clinical risk factor for venous thromboembolism?
- A.** 10%
  - B.** 20%
  - C.** 30%
  - D.** 40%
  - E.** 50%

**Answer: E.** The point here is that being healthy does not rule out the possibility of VTE. Risk factors are best applied to population analysis and are of very limited use when evaluating a single patient.

## KEY CONCEPTS

**Dysphagia**

- Dysphagia can be caused by obstructive lesions (aortic aneurysm), motility disorders (achalasia) and neuromuscular disorders that can be vascular (eg, cerebral vasculature accident), immunologic (eg, multiple sclerosis [MS]), infectious (eg, botulism), or metabolic in nature.
- The incidence of achalasia increases with age, presenting insidiously with equal frequency for solids and liquids.
- Dysphagia can be the initial presentation of myasthenia gravis.
- Treatment is directed toward the underlying cause (eg, myasthenia gravis, MS).
- An outpatient barium swallow or endoscopy is indicated for most patients with dysphagia.

**Foreign Bodies**

- Structural abnormalities of the esophagus are a major risk factor for foreign body obstruction, so patients who obtain relief of symptoms should be referred to a gastroenterologist for follow-up evaluation.
- Emergent (immediate) intervention is indicated for button batteries, food boluses causing high-grade obstruction, and patients in significant distress.
- Urgent (<24 hours and ideally <12 hours) intervention is indicated for no or low-grade obstructions caused by sharp objects, coins lodged in the proximal esophagus, and food boluses.
- Urgent intervention is recommended for gastric foreign bodies wider than 2.5 cm or longer than 5 cm.
- Flexible endoscopy with procedural sedation is the preferred therapeutic intervention to remove most foreign bodies.

**Esophageal Perforation**

- Iatrogenic causes, such as endoscopy, are the most common cause of esophageal perforations.
- Water-soluble contrast should be used for initial diagnostic imaging studies.
- Admission with broad-spectrum antibiotics (eg, vancomycin, 15 mg/kg and piperacillin, 3.375 g) and early surgical consultation should occur in most cases of esophageal perforation.
- Select stable patients with a small, contained esophageal perforation may be managed conservatively by keeping the patient NPO, scheduling broad-spectrum antibiotics, using parenteral nutrition, and having a surgeon readily available.

**Esophagitis**

- GERD is a diagnosis of exclusion in patients who present with chest pain. It is critical to first rule out other diagnoses, such as ACS.
- Empirical treatment of GERD with lifestyle modifications, H<sub>2</sub> blockers, or PPIs is appropriate, but if no improvement with these measures, the patient should be referred for further evaluation.
- Sucralfate (1 g qid) is a useful adjunct in the treatment of GERD and can be safely used in pregnant patients.
- Eosinophilic esophagitis commonly presents as solid food dysphagia. Once food impaction is ruled out, a PPI should be started and the patient referred to a gastroenterologist.
- Infectious esophagitis primarily occurs in immunocompromised patients, and its specific cause can be identified by endoscopy.
- Patients with pill esophagitis typically present with sudden onset retrosternal pain and odynophagia in the setting of taking medications without water. In such cases, the diagnosis can be made clinically on the history alone.
- Medications associated with pill esophagitis include doxycycline, aspirin, NSAIDs, and potassium chloride.

**Gastritis and Peptic Ulcer Disease**

- Although gastritis cannot be definitively diagnosed based on clinical features alone, a clinical history such as recent NSAID use or alcohol ingestion in the setting of the classic symptoms supports a presumptive clinical diagnosis of gastritis.
- The most common cause of gastritis is *H. pylori* infection.
- First-line treatment of *H. pylori* infection is a PPI (eg, omeprazole, 20 mg bid), amoxicillin (1 g bid) and clarithromycin (500 mg bid) for 14 days.
- The most serious complications of PUD include hemorrhage, perforation, penetration, and gastric outlet obstruction.

**Gastric Volvulus**

- Acute gastric volvulus often presents with the combination of severe epigastric pain and distention and vomiting followed by violent nonproductive retching.
- Volvulus has a very high morbidity and mortality. Nasogastric tube reduction can be attempted in the ED, but ultimately these patients need emergent surgical consultation.

## CHAPTER 79: QUESTIONS &amp; ANSWERS

79.1. What is an appropriate first-line treatment regimen for *H. pylori* infection?

- A. Bismuth subsalicylate, ranitidine, and clarithromycin
- B. Metronidazole and sucralfate
- C. Omeprazole, amoxicillin, and clarithromycin
- D. Omeprazole and bismuth subsalicylate
- E. Ranitidine, omeprazole, and amoxicillin

**Answer: C.** The recommended triple-treatment regimen for *H. pylori* infection is a PPI (eg, omeprazole, 20 mg bid), amoxicillin (1 g bid), and clarithromycin (500 mg bid) for 14 days. Quadruple therapy with Pepto Bismol, metronidazole, tetracycline, and a PPI-ranitidine is an alternative option. See [Box 79.5](#).

79.2. What percentage of esophageal foreign bodies require an intervention (usually nonoperative) for removal?

- A. <10%
- B. 10%–20%
- C. 20%–30%
- D. 30%–40%
- E. >40%

**Answer: B.** Most foreign bodies pass spontaneously. Approximately 10%–20% require intervention, but less than 1% require surgery for removal.

79.3. A 5-year-old child is brought to the ED by his mother after a possible ingestion of a plastic Lego piece. He has had no pulmonary symptoms but reports difficulty swallowing and declines to drink liquids that are offered. What would be the intervention of choice?

- A. Contrast-enhanced CT scan of the chest
- B. Endoscopy
- C. Non-water-soluble barium swallow
- D. Posteroanterior and lateral chest radiography
- E. Water-soluble barium swallow

**Answer: B.** Because the patient is symptomatic, endoscopy is indicated. A CT scan of the chest is useful for organic and inorganic materials. A basic chest radiograph cannot reliably exclude a foreign body. Barium swallow is difficult in pediatric patients, particularly this child, who is refusing oral fluids. Water-soluble media risk pneumonitis if aspirated. Non-water-soluble materials risk increased inflammation if leakage occurs into the mediastinum. Barium may also obscure subsequent endoscopic visualization.



- 79.4. Which of the following statements regarding the pharmacologic treatment of an esophageal obstruction from a food bolus is true?
- A. Carbonated beverages are a safe and useful adjunct at any point.
  - B. Glucagon has the additional benefit of moderate antiemetic properties.
  - C. Glucagon has been proven to help facilitate passage of a food bolus anywhere in the esophagus.
  - D. Glucagon is contraindicated with sharp-edged foreign bodies.
  - E. Papain (meat tenderizer) can be used to soften a food bolus and help with passage.

**Answer: D.** Glucagon is a smooth muscle relaxant, so it is theoretically useful only for distal esophageal foreign bodies. There are only anecdotal reports of success with glucagon, but no randomized controlled trials have shown a statistical benefit over placebo. There are many adverse effects, including flushing, nausea, and vomiting, that can potentially increase the risk of aspiration. It is contraindicated for use with sharp or damaging foreign bodies. There is only low-level evidence to support the use of effervescent agents, and they are relatively contraindicated after 24 hours because of perforation concerns. The use of meat tenderizer (papain) should be avoided because it can significantly worsen inflamed mucosa and increase the risk of perforation.

- 79.5. Which of the following is an indication for urgent endoscopy?
- A. Button battery in the stomach
  - B. Chest pain due to foreign body
  - C. Coin in the proximal esophagus
  - D. Nausea and vomiting
  - E. Object failing to pass out of the esophagus after 12 hours

**Answer: C.** A coin that remains lodged in the proximal esophagus should be removed. Other indications are inability to handle secretions, sharp objects, esophageal button battery (alkaline) in the esophagus, and impactions that fail to pass after 24 hours.

- 79.6. By the age of 50 years, what percentage of the population has endoscopic evidence of gastritis?
- A. 10%
  - B. 20%
  - C. 30%
  - D. 40%
  - E. 50%

**Answer: E.**

- 79.7. A 32-year-old otherwise healthy man presents with acute onset of epigastric pain radiating to his chest that woke him from sleep at 2 AM. It was a burning pain associated with water brash. There were no associated pulmonary symptoms. His past medical history is negative except for tobacco use and heartburn. His electrocardiogram is normal and his upright chest radiograph is also normal. Vital signs and physical examination findings are unremarkable. He is currently pain-free. His troponin level is normal. What would be the most appropriate intervention?
- A. Cardiology consultation for catheterization
  - B. Contrast-enhanced CT scan of the chest
  - C. Discharge on aspirin, 325 mg once daily
  - D. Serial troponins
  - E. Trial of twice-daily proton pump inhibitors

**Answer: E.** Peak gastric acid secretion occurs during the early morning hours between 1 a.m. and 3 a.m., with a typical scenario of being awakened from sleep. The shared afferent neural pathway makes the pain of gastroesophageal reflux disease (GERD) often similar to that of pain of cardiac origin. Gastric acid secretion is lowest at approximately 6 AM, so awakening in the morning with pain from GERD is unusual.

- 79.8. A 45-year-old woman presents several hours after an upper endoscopy with severe chest pain and neck discomfort. She is awake and alert, but rates pain as 10 of 10. What is the most appropriate test to confirm the diagnosis?
- A. Abdominal x-ray
  - B. Barium contrast esophagography
  - C. Gastrografin (water-soluble) contrast esophagography
  - D. Ultrasound
  - E. Upper endoscopy

**Answer: C.** We recommend an initial attempt with a water-soluble agent in patients who are awake and alert and are not at risk for aspiration. Barium sulfate is superior for identifying small perforations; however, it may incite an inflammatory response in tissue and should only be used if no initial perforation is identified with water-soluble contrast. Endoscopy is generally not recommended except in cases of penetrating trauma because insufflation could potentially enlarge a minimal transmural opening.

## KEY CONCEPTS

### Hepatitis

#### Viral Hepatitis

The clinical presentation of viral hepatitis is highly variable, and many cases, particularly in children, are asymptomatic.

- Incubation times vary—hepatitis A, 15–45 days; hepatitis B, 60–90 days; hepatitis C, 30–90 days.
- Highly effective immunizations exist against hepatitis A and B viruses.
- Postexposure, passive immunization exists for hepatitis A and B viruses but its use is mainly limited to nonimmunized, hepatitis B–exposed individuals.
- Direct-acting antiviral regimens using nucleoside inhibitors have revolutionized hepatitis treatment. A sustained virologic response with negative HCV RNA testing is achieved in over 90% of individuals.
- Viral hepatitis is a reportable disease. Additional care in the ED and patient education should be provided to prevent disease spread.
- The process of identifying the causative agent or source should be initiated because it affects disease prognosis and public health.

#### Alcoholic Hepatitis

- Liver disease caused by alcohol use progresses from steatosis to fibrosis to cirrhosis, and finally to hepatocellular carcinoma. Hepatitis may accompany the cirrhosis.
- With cessation of alcohol intake, steatosis may reverse within 2 weeks.
- Alcoholic hepatitis, although generally a mild disease with minor clinical manifestations, can be a cause of fulminant hepatitis.
- Laboratory tests may help distinguish alcoholic hepatitis from viral hepatitis in that the former is associated with milder enzyme level elevations and a relative predominance of AST to ALT levels.
- Management of patients with alcoholic hepatitis should include fluid and electrolyte repletion, a high-calorie and vitamin-supplemented diet, and referral for alcohol dependence treatment.
- Variceal bleeding is treated with octreotide (50- $\mu$ g bolus followed by 50  $\mu$ g/h), somatostatin (250- $\mu$ g bolus and 250- $\mu$ g/hour infusion), or vasopressin (0.4-unit bolus followed by 0.4–1 unit/min continuous infusion) is important.
- Oral prednisone, 40 mg daily, or IV methylprednisolone, 32 mg daily, should be used for patients with alcoholic hepatitis and mDF more than 32.

#### Cirrhosis

Patients with cirrhosis most often present to the ED with complications of their disease—ascites, variceal bleeding, hepatorenal syndrome, or hepatic encephalopathy.

- Impaired hepatic synthetic and metabolic function in patients with cirrhosis may necessitate correction of coagulopathy before invasive procedures and modification of medication dosage.
- Prior to performing procedures, the targeted platelet count should be more than 50,000/mm<sup>3</sup>.
- When volumes more than 5 L are removed during paracentesis to treat ascites, albumin, (8 g/L of ascitic fluid removed) should be given.
- Cryoprecipitate, 1 unit/10 kg body weight, is preferred over fresh-frozen plasma when treating liver-associated coagulopathies in a patient with active bleeding.
- Angiotensin-converting enzyme inhibiting drugs and angiotensin receptor blocking drugs should be avoided in patients with cirrhosis. Both lower mean arterial blood pressure and may increase mortality.
- Hepatorenal syndrome is heralded by an increasing creatinine level in the setting of liver failure. It is associated with a high rate of mortality and should be managed with norepinephrine, 0.5–3 mg/h in combination with albumin 1 g/kg (maximum, 100 g).

#### Hepatic Encephalopathy

- Hepatic encephalopathy is a state of cerebral and neuromuscular dysfunction secondary to increased ammonia levels and their effects on cerebral metabolism.

- The severity of hepatic encephalopathy does not directly correlate with the serum ammonia level.
- Consideration and evaluation for underlying exacerbating conditions, such as GI bleeding, hypokalemia, infection and dehydration, should be undertaken during the evaluation and treatment of hepatic encephalopathy.
- The differential diagnosis for hepatic encephalopathy should consider all causes of altered sensorium. The broad scope of the differential diagnosis may necessitate additional testing, including serum chemistry, CSF studies, toxicology studies, and head CT scanning.
- Management of hepatic encephalopathy includes correction of underlying electrolyte abnormalities, dietary guidance, administration of lactulose (30–60 g/day) and rifaximin (400 mg tid).
- L-Ornithine–L-arginine may be added to the regimen and has demonstrated ability to lower serum ammonia levels.
- Probiotics, acarbose, flumazenil, and polyethylene glycol require further investigation in the treatment of hepatic encephalopathy.

#### Spontaneous Bacterial Peritonitis

- SBP should be considered in any patient with ascites with abdominal pain, fever, or unexplained clinical deterioration.
- *E coli* and *Klebsiella* remain the two most commonly identified organisms in SBP.
- The diagnosis of SBP is dependent on obtaining ascitic fluid for cell count and culture.
- Use of leukocyte esterase reagent strips may provide a convenient means of bedside screening of ascitic fluid for SBP.
- An ascitic fluid granulocyte count greater than 250 cells/mm<sup>3</sup> (100 cells/mm<sup>3</sup> in peritoneal dialysis patients) is an indication for antibiotic treatment.
- Treatment of SBP includes cefotaxime, 2 g tid, for 5 days.
- Additional testing and imaging may assist in differentiating SBP from peritonitis secondary to other abdominal or lung pathologies.

#### Hepatic Abscesses

- Pyogenic abscesses often occur in the right lobe of the liver from anaerobic or aerobic microbes.
- Abdominal ultrasound and CT are the imaging modalities of choice.
- Imaging does not distinguish pyogenic from amebic abscesses.
- Treatment should be initiated prior to abscess drainage.
- Treatment regimens for pyogenic abscess include:
  - Cefotaxime + metronidazole
  - Ampicillin + gentamycin + metronidazole
  - Ciprofloxacin or levofloxacin or moxifloxacin + metronidazole
  - Piperacillin-tazobactam
  - Imipenem or meropenem, or doripenem or ertapenem
- Definitive treatment for abscesses larger than 3 cm includes image-guided percutaneous drainage.
- Surgical drainage is reserved for complex cases.

#### Amebic Abscess

- Although similar in many ways to pyogenic abscess, diagnosis is made via stool analysis or ELISA testing.
- Most patients will have elevation in alkaline phosphatase and aminotransferase levels.
- Ultrasound may reveal specific findings unique to an amebic abscess, including a peripherally located abscess with a well-circumscribed border and a homogeneous, hypoechoic center.
- Coupled with imaging, laboratory data including ELISA or counterimmune electrophoresis may aid in differentiating amebic from pyogenic abscesses.
- Definitive treatment of amebic abscess is amebicidal therapy with IV or oral metronidazole (750 mg tid for 7–10 days).

#### Cholelithiasis

- Biliary colic should be considered in patients with nausea, vomiting, and RUQ pain.

## KEY CONCEPTS—cont'd

- Diagnosis with ultrasound of the biliary system and possibly laboratory abnormalities suggests obstruction of the biliary tree.
- Initial management is supportive, with the goal of treating pain and correcting fluid and electrolyte abnormalities.
- Patients without findings of infection who are tolerating oral intake may be managed in the outpatient setting.
- Definitive care requires outpatient surgical referral for cholecystectomy.

### Cholecystitis

- The vast majority of patients with cholecystitis have gallstones; however, approximately 8% have acalculous disease. The latter group of patients tend to have more severe disease and are at increased risk for complications.
- Despite an unclear relationship between bacterial infection and pathophysiology, antibiotic therapy is recommended.

- Combination therapy with a third-generation cephalosporin and metronidazole or monotherapy with a carbapenem or  $\beta$ -lactamase inhibitor is recommended.
- Patients with acalculous and emphysematous cholecystitis are at increased risk for gangrene and perforation and require emergency cholecystectomy.

### Cholangitis

- Cholangitis is an emergency condition resulting from extrahepatic bile duct obstruction and bacterial infection.
- The classically seen triad consists of RUQ pain, fever, and jaundice
- Effective management requires prompt fluid resuscitation and administration of broad-spectrum antibiotics.
- Definitive management includes hospitalization and early biliary tract decompression, which can be achieved surgically, transhepatically, or by ERCP.

## CHAPTER 80: QUESTIONS & ANSWERS

**80.1.** Which of the following statements regarding hepatitis A is true?

- A. Fecal shedding and highest infectivity coincide with symptomatic disease.
- B. In the United States, approximately 20% of urban-dwelling adults are seropositive.
- C. Occult disease is more common in children than in adults.
- D. The incidence of it is fairly consistent across ethnic groups.
- E. The most common risk factor for children is travel.

**Answer: C.** Children are more likely to have occult disease (up to 70%). Adult seropositive rates approach 50% among urban-dwelling adults. The incidence varies widely across ethnic groups. In areas of pediatric vaccinations, increasing adult cases are seen among intravenous drug users (IVDUs) and homosexual males. The stage of highest infectivity precedes symptoms.

**80.2.** Which of the following statements concerning hepatitis D infection is true?

- A. Hepatitis D is spread primarily via the fecal-oral route.
- B. Infection with hepatitis D is an independent event with a course nearly identical to that of hepatitis A.
- C. It is common to see aspartate aminotransferase (AST) level elevations far in excess of alanine aminotransferase (ALT) level elevations.
- D. Many cases are misdiagnosed as acute or reactivated hepatitis B.
- E. Unconjugated bilirubin levels are 2 or 3 times higher than conjugated levels.

**Answer: D.** Hepatitis D virus infection can only occur with (coinfection) or after (superinfection) hepatitis B infection. It is spread via the parenteral route, such as by IV drug use. Many cases are misdiagnosed as acute or reactivated hepatitis B because B markers will be positive. There are no unique biochemical or laboratory patterns for any of the viral hepatitis infections. Hepatitis D does seem to have a direct cytotoxic potential as opposed to other viral causes, where the host immunologic response causes much of the hepatitis.

**80.3.** A 26-year-old man presents with complaints of pruritus and a raised rash for 7 days. The rash has been associated with nausea and painful symmetrical swelling of both wrists and metacarpophalangeal joints. He has no past medical history and takes no medications. He works in a retail store. Vital signs are normal, and the physical examination is remarkable for right upper quadrant tenderness, bilateral mild wrist effusion with minimal warmth and no erythema, and diffuse skin urticaria. The remainder of the examination is negative. Blood count, chemistries, and liver studies are remarkable for WBC, 11,800 cells/mm<sup>3</sup>, AST, 212 IU/L, ALT, 395 IU/L, normal alkaline phosphatase level, and total bilirubin of 2.3 mg/dL. Which of the following tests would be most likely to yield the diagnosis?

- A. CMV titers
- B. Hepatitis A antigen
- C. Hepatitis B surface antigen
- D. Herpes simplex I titers
- E. Monospot test

**Answer: C.** A small number of patients with hepatitis B develop a prodrome of arthralgias and arthritis (symmetric small joints) and dermatitis. The dermatitis is typically urticarial but may be macular, papular, or petechial.

**80.4.** Scleral icterus becomes clinically apparent at approximately which serum bilirubin level?

- A. 2 mg/dL
- B. 2.5 mg/dL
- C. 3 mg/dL
- D. 3.5 mg/dL
- E. 4 mg/dL

**Answer: B.** Icterus is often first noted in the sublingual or subungual areas.

- 80.5.** Which of the following statements regarding the typical laboratory profile for a patient with acute viral hepatitis is true?
- A. AST is generally elevated in excess of ALT.
  - B. Direct and indirect bilirubin are elevated in almost equal proportions.
  - C. Lactate dehydrogenase (LDH) levels are almost always normal.
  - D. The alkaline phosphatase level is generally elevated 5 to 10 times normal.
  - E. The WBC generally shows a marked polymorphonuclear leukocytosis.

**Answer: B.** The alkaline phosphatase level is rarely elevated more than 2 or 3 times normal, and LDH levels are modestly elevated. The WBC count may range from low, with lymphocytic predominance, to a polymorphonuclear (PMN)-predominant leukocytosis. ALT is almost always elevated in excess of AST.

- 80.6.** A 26-year-old woman returns for follow-up after initial evaluation for possible acute hepatitis. Her hepatitis panel has returned with the following results:

|                                 |          |
|---------------------------------|----------|
| Hepatitis A IgM                 | Negative |
| Hepatitis A IgG                 | Negative |
| Hepatitis B surface antigen     | Positive |
| Hepatitis B surface antigen IgG | Negative |
| Hepatitis B core antigen IgM    | Positive |
| Hepatitis B core antigen IgG    | Negative |
| Hepatitis C antigen             | Negative |

Which of the following is the most appropriate diagnosis?

- A. Acute hepatitis A
- B. Acute hepatitis B
- C. Immunity to hepatitis B
- D. Previous hepatitis A
- E. Previous hepatitis B

**Answer: B.** Acute hepatitis A is characterized by IgM to hepatitis A. Prior infection is determined by IgG antibody. Acute hepatitis B is characterized by the presence of surface antigen and IgM antibody to core antigen. Surface antigen alone may be absent late in the course of the disease or may present chronically unrelated to the current episode. IgG to the core antigen indicates previous infection. IgG to the surface antigen is the best marker for immunity.

- 80.7.** A 39-year-old man presents with a 4-day history of abdominal pain and nausea. He has no significant past history and takes no medications. Vital signs are temperature, 37.7°C (99.9°F) oral, heart rate (HR), 98 beats/min, respiratory rate (RR), 20 breaths/min, and blood pressure, 119/68 mm Hg. The physical examination reveals scleral icterus, a normal cardiopulmonary examination, moderate right upper quadrant tenderness without rebound, and guaiac-negative stool. Laboratory assessment reveals the following:

|                           |                         |
|---------------------------|-------------------------|
| Total bilirubin           | 9.8 mg/dL               |
| Conjugated bilirubin      | 4.6 mg/dL               |
| Unconjugated bilirubin    | 5.2 mg/dL               |
| AST                       | 5300 IU/L               |
| ALT                       | 8400 IU/L               |
| Alkaline phosphatase      | 750 IU/L                |
| Albumin                   | 3.9 mg/dL               |
| INR                       | 1.2                     |
| Hematocrit                | 42%                     |
| Platelet count            | 396,000/mm <sup>3</sup> |
| WBC                       | 9900/mm <sup>3</sup>    |
| Blood urea nitrogen (BUN) | 53 mg/dL                |
| Creatinine                | 0.9 mg/dL               |

Which of the following courses of action is most appropriate?

- A. Admission for observation and GI consultation
- B. CT scan of the abdomen with contrast
- C. Gastrointestinal (GI) referral for interferon therapy
- D. Reassurance
- E. Tapering course of corticosteroids

**Answer: A.** Altered sensorium and prolongation of the PT beyond 5 seconds or INR beyond 1.5 suggest fulminant hepatic failure. Similarly, an unexplained elevation of the BUN or creatinine level may portend hepatorenal syndrome, which can be fatal. The BUN level elevation in this hepatitis patient warrants admission for hydration, close observation, and GI consultation. Interferon has had some success in symptomatic hepatitis B patients but does not affect the early course. There is no role for corticosteroids.

- 80.8.** The risk of liver injury in men increases as daily consumption of alcohol exceeds which of the following?
- A. 10 g
  - B. 20 g
  - C. 40 g
  - D. 60 g
  - E. 80 g

**Answer: E.** This is equivalent to a six-pack of beer, four to six glasses of wine, or three or four mixed drinks daily. For women, the risk increases with a daily consumption of more than 20 g of alcohol.

- 80.9.** A 63-year-old alcoholic man presents with altered mental status. His family reports 3 days of decreasing ambulation and increasingly nonsensical conversation. He has no other known past medical history and takes no medications. Vital signs are unremarkable. The physical examination reveals a thin, unkempt man who is oriented to person only but is cooperative and follows commands. He falls asleep easily. There is no scleral icterus, and cardiopulmonary, abdominal, stool guaiac, and neurologic examinations are negative. A noncontrast CT scan of the head is negative. Pertinent laboratory findings are as follows:

|                      |                         |
|----------------------|-------------------------|
| Hematocrit (HCT)     | 34%                     |
| Hemoglobin           | 11.4 g/dL               |
| Platelet count       | 108,000/mm <sup>3</sup> |
| WBC                  | 9300/mm <sup>3</sup>    |
| AST                  | 148 IU/L                |
| ALT                  | 86 IU/L                 |
| Total bilirubin      | 2 mg/dL                 |
| Albumin              | 2.2 mg/dL               |
| Alkaline phosphatase | 158 IU/L                |
| INR                  | 1.8                     |
| BUN                  | 38 mg/dL                |
| Creatinine           | 2.1 mg/dL               |
| Ethanol              | 0 mg/dL                 |
| Bicarbonate          | 30 mmol/L               |
| Sodium               | 133 mEq/L               |
| Potassium            | 3.6 mEq/L               |
| Chloride             | 95 mEq/L                |

What is the most appropriate intervention?

- A. Admission for lactulose, 30 to 60 g daily, titrated to modest diarrhea
- B. Determination of further therapy, admission, and treatment based on serum ammonia levels
- C. Discharge with the family; neomycin, 500 mg every 4 to 6 hours
- D. Oral metronidazole, 250 mg qid
- E. Oral vitamin K for 2 weeks

**Answer: A.** Ammonia accumulates in severe liver disease and crosses the blood-brain barrier to eventually form glutamine. Ammonia levels correlate poorly with encephalopathy. Lactulose is an osmotic cathartic that acidifies colonic contents, causing ammonia trapping. Neomycin is a poorly absorbed aminoglycoside that reduces colonic bacteria but is relatively contraindicated in cases of renal insufficiency. Therapies for hepatic encephalopathy that have been under clinical investigation include metronidazole, zinc, flumazenil, and eradication of *Helicobacter pylori*. Vitamin K would have modest benefit due to loss of hepatic synthetic abilities. Plasma would not be indicated unless active bleeding occurred.

**80.10.** A 23-year-old G2P1 woman at 35 weeks of gestation presents with 3 days of fatigue, anorexia, nausea, and vomiting. She reports moderate epigastric and right upper quadrant pain. The physical examination is remarkable for icteric sclerae, slightly dry mucous membranes, and moderate tenderness in the right upper quadrant. She is afebrile and her uterus is not tender. Urgent ultrasound shows a viable moving fetus at 34 weeks' estimated gestational size, with good cardiac activity, and liver and gallbladder ultrasound reveals no obvious gallstones or ductal dilations but moderate hepatomegaly. Laboratory analysis is remarkable for the following:

|                        |                         |
|------------------------|-------------------------|
| AST                    | 1050 IU/L               |
| ALT                    | 1265 IU/L               |
| Total bilirubin        | 9.9 mg/dL               |
| Conjugated bilirubin   | 4.6 mg/dL               |
| Unconjugated bilirubin | 5.2 mg/dL               |
| Alkaline phosphatase   | 328 mg/dL               |
| Glucose                | 62 mg/dL                |
| Hemoglobin             | 9.3 g/dL                |
| Platelet count         | 105,000/mm <sup>3</sup> |
| Normal electrolytes    |                         |
| Creatinine             | 0.6 mg/dL               |
| Prothrombin time       | 14.8 sec                |
| Albumin                | 3.1 g/dL                |

What is the most appropriate treatment?

- A. Clear liquids, antiemetics, and follow-up outpatient ultrasound in 48 hours
- B. Contrast CT scan of the abdomen
- C. Hydration, antiemetics, and discharge after symptom resolution
- D. Intensive care unit admission for monitoring for DIC
- E. Stabilization and urgent delivery

**Answer: E.** Acute failing liver of pregnancy typically presents in the latter third trimester. Treatment involves aggressive fluid and electrolyte support, glucose administration, and immediate delivery. Liver disease generally resolves without sequelae. The illness is more common in primigravidas and twin pregnancies.

**80.11.** What is the most sensitive and specific imaging test for acute cholecystitis?

- A. Contrast CT scan
- B. Nuclear scintigraphy with iminodiacetic acid (IDA)
- C. Serum alkaline phosphatase level
- D. Serum bilirubin level
- E. Ultrasonography

**Answer: B.** IDA administered IV is taken up by hepatocytes and secreted into bile canaliculi. Visualization of the gallbladder and common duct within 1 hour has a negative predictive value of 98%. Scintigraphy with IDA loses its sensitivity at bilirubin levels of 5 to 8 mg/dL.



## KEY CONCEPTS

- Acute pancreatitis represents a wide spectrum of disease, ranging from mild, short-lived disease to severe life-threatening disease with a mortality rate as high as 30%.
- Most cases of acute pancreatitis are caused by gallstones, followed closely by alcohol abuse.
- Diagnosis of acute pancreatitis relies on the presence of at least two of these three criteria—typical clinical features, serum amylase or lipase level 3 times the upper limit of normal, confirmatory imaging.
- Determining the serum lipase level is preferred over the amylase level because of its greater sensitivity and specificity.
- CT does not need to be performed routinely, but only for cases of diagnostic uncertainty or in the later phases to rule out complications.
- Following the diagnosis of pancreatitis, abdominal ultrasound should be performed early to determine if the cause is biliary.
- Treatment of acute pancreatitis is mainly supportive, with fluid resuscitation and pain control paramount. Lactated Ringer's solution is more physiologic than normal saline and may confer better outcomes in patients receiving large volumes of fluids. There is no evidence to support one analgesic agent over another.
- Antibiotics are not indicated for prophylaxis and are not purely based on SIRS criteria, but should be given in cases of infected pancreatic necrosis or other clear evidence suggesting infection.
- ERCP is only indicated in cases of cholangitis or biliary obstruction.
- Most patients require hospitalization for symptomatic control, monitoring of hydration and nutrition status, and management of complications.
- There is no perfect scoring system to help predict severity and outcomes in pancreatitis. The most widely accepted systems include Ranson's, APACHE-II, CTSI, and BISAP. Each has different strengths and weaknesses.

## CHAPTER 81: QUESTIONS &amp; ANSWERS

**81.1.** A 28-year-old woman presents with recurrent pancreatitis.

She is otherwise healthy and takes no medications. This episode of pain was preceded by several similar episodes of intermittent epigastric pain that lasted several hours at a time. A previous ultrasound examination of the liver, gallbladder, and pancreas was normal. She does not smoke, drink, or use over-the-counter medications. The physical examination is remarkable for moderate epigastric tenderness without rebound. Vital signs are normal. Laboratory evaluation reveals an elevated lipase level and moderate leukocytosis. Urinalysis and urine pregnancy test results are normal. What would be the most appropriate intervention?

- After stabilization, referral to a gastroenterologist for endoscopic retrograde cholangiopancreatography (ERCP)
- After stabilization, referral to a gastroenterologist for upper endoscopy
- Computed tomography (CT) scan of the abdomen to rule out pancreatic pseudocyst
- Repeated ultrasound examination of the liver, gallbladder, and pancreas
- Symptomatic treatment only unless her clinical picture worsens

**Answer: A.** Many cases of presumed idiopathic pancreatitis may be due to small stones or sludge that cannot be seen by ultrasound examination but may be seen by ERCP. Pancreatic pseudocyst is more likely in alcoholic pancreatitis and typically occurs gradually, several months after a severe episode.

**81.2.** Which of the following statements regarding acute pancreatitis is true?

- Acute pancreatitis may develop in 20% to 30% of ERCP cases.
- The most common adult cause is alcohol abuse.
- The most common geriatric cause is infection.
- The most common pediatric causes are trauma and infection.
- The most common viral cause is HIV infection.

**Answer: D.** The most common viral causes are mumps and coxsackievirus. B. The most common adult and geriatric cause is gallstones. Acute pancreatitis is seen in 1% to 10% of ERCP cases.

**81.3.** Which of the following statements about the serum amylase level is true?

- Elevations may be seen after muscle trauma.
- In acute pancreatitis, levels rise in 1 or 2 hours and normalize in 2 days.
- Increasing the cutoff value decreases the sensitivity for detection of pancreatitis.
- It is a less sensitive test than the serum lipase level for the diagnosis of pancreatitis.
- It is not renally cleared.

**Answer: A.** Although amylase is produced primarily in the pancreas and salivary glands, other sources are muscle, testes, ovaries, small intestine, and fallopian tubes. Levels rise within 6 to 24 hours and normalize in 3 to 7 days. Amylase is renally excreted. Levels may be normal in up to 25% of pancreatitis cases and elevated in normal individuals. It is likely to be as sensitive as the serum lipase level but is less specific. Increasing the cutoff value decreases the sensitivity but increases the specificity.

**81.4.** Which of the following statements regarding the use of radiographic studies for the evaluation of pancreatitis is true?

- CT is indicated in pancreatitis if there is acute deterioration.
- Oral administration of a contrast agent for abdominal CT may aggravate pancreatitis.
- The study of choice in suspected gallstone pancreatitis is ultrasonography.
- Ultrasonography and CT of the abdomen are equally accurate for visualizing the biliary tract.
- Ultrasonography may help differentiate pancreatitis from pancreatic pseudocyst.

**Answer: A.** There is no perfect test. Ultrasonography has a sensitivity of 94% for gallstones but far less for common bile duct stones or biliary dilation, for which ERCP is the test of choice because of its sensitivity for detecting small duct stones or strictures. CT is excellent for ruling out other causes of abdominal pain (eg, pseudocyst, abscess, necrosis, vascular abnormalities, hemorrhage) and is indicated if the diagnosis is uncertain, if fever and leukocytosis are present, and with acute deterioration. Oral contrast material does not aggravate pancreatitis. A non-contrast-enhanced helical scan may also be helpful if an oral contrast agent cannot be tolerated.

## KEY CONCEPTS

**Small Bowel Obstruction**

- The most common cause of SBO is postoperative adhesions. Other common causes include neoplasm and hernias.
- Abdominal CT with IV contrast is the gold standard for imaging in cases of suspected SBO. It is sensitive and specific and provides information about the cause of the obstruction and potential complication of strangulation.
- Bedside ultrasound for SBO may be a potentially useful imaging modality, but more research is needed.
- Many patients with SBO will improve with nonoperative conservative treatment; however, prompt surgical exploration is recommended when there is suspected bowel strangulation.
- Antibiotics are not indicated in cases of simple SBO.
- The recurrence rate for SBO is high, regardless whether treatment is operative or nonoperative.

**Acute Mesenteric Ischemia**

- Acute mesenteric ischemia (AMI) is a rare vascular catastrophe, with a very high mortality.
- AMI should be considered in patients older than 50 years with a history of cardiac disease who have acute abdominal pain, which

may initially appear severe and out of proportion to physical examination findings.

- Within the diagnosis of AMI are four distinct clinical entities with specific associated risk factors, clinical presentations, and treatments—mesenteric arterial embolism, mesenteric arterial thrombosis, nonocclusive mesenteric ischemia, and mesenteric venous thrombosis.
- Although no current laboratory test has sufficient sensitivity or specificity to diagnose acute mesenteric ischemia alone, determination of the serum L-lactate level is currently the most useful.
- CT angiography is the initial imaging test of choice for the evaluation of suspected AMI.
- Successful management of acute mesenteric arterial embolism and thrombosis frequently requires multispecialty, care including general or vascular surgery, interventional radiology, and critical care, with the goal of restoring mesenteric blood flow as quickly as possible.
- Unlike cases of arterial embolism or thrombosis, in the absence of peritonitis, mesenteric venous thrombosis is often successfully managed with heparin alone.

## CHAPTER 82: QUESTIONS &amp; ANSWERS

**82.1.** What is the most common cause of small bowel obstruction in the developed world?

- Gallstone ileus
- Hernias
- Intussusception
- Postoperative adhesions
- Tumors

**Answer: D.** In the developed world, postoperative adhesions account for approximately 60% of cases of small bowel obstruction. Patients with a history of intestinal or pelvic surgery are at the highest risk.

**82.2.** Which of the following patients are at the highest risk of developing an obturator hernia?

- 2-year-old boy with no known medical problems
- 45-year-old woman with a 1-year history of hysterectomy
- 67-year-old man with a history of metastatic prostate cancer
- 80-year-old woman with a 3-month history of rapid weight loss

**Answer: D.** This type of hernia is especially common in older women who have recently lost a significant amount of weight. The female pelvis is wider, and the obturator canal is more oblique in women. This, in combination with a loss of preperitoneal fat, predisposes to its development. Because an external mass is absent, diagnosis is especially challenging and explains why it carries the highest mortality of any abdominal hernia, at nearly 70% when incarcerated.

**82.3.** A 55-year-old woman with a history of Roux-en-Y gastric bypass surgery presents with a 1-day history of worsening colicky abdominal pain and vomiting. A CT scan reveals an internal hernia. What is the most appropriate disposition?

- Administer broad-spectrum antibiotics and admit to the medicine floor.
- Arrange for barium swallow with small bowel follow-through
- Insert nasogastric tube and admit to the medicine floor.
- Prompt surgical consultation and preparation for surgery should occur.

**Answer: D.** Although rare in the general population, internal hernias are a recognized complication of bariatric surgery, especially when a Roux-en-Y type procedure has been performed. Because of the closed loop nature of an internal hernia, they are not suitable for conservative management and require surgical intervention.

**82.4.** What is the length of time from acute absolute ischemia of the intestines to completion of transmural necrosis?

- 15 minutes
- 60 minutes
- 2 hours
- 6 hours
- 24 hours

**Answer: D.** Although the mesenteric circulation is able to adapt to variations in circulation, the small bowel is quickly injured after acute ischemia. Within 15 minutes, structural damage to the intestinal villi can be seen histologically. If blood flow is not restored, mucosal sloughing can start to occur within 3 hours and, by 6 hours, transmural necrosis is complete.

**82.5.** A 35-year-old woman who currently smokes while taking oral contraceptive pills presents with 2 days of progressively worsening diffuse abdominal pain without peritoneal findings on examination. A CT scan reveals mesenteric venous thrombosis. What is the next most appropriate step?

- Arrange for formal mesenteric venous angiography to confirm and treat.
- Arrange for immediate exploratory laparotomy regardless of current clinical status, given the high risk of severe complications.
- Discharge home because this will resolve without intervention.
- Institute pain control and admit to the floor.
- Start anticoagulation with therapeutic dosing of heparin.

**Answer: E.** The treatment of mesenteric venous thrombosis is unique in that in the absence of peritoneal findings, initial treatment with heparin alone may be adequate. In the vast majority of cases (>75%) an underlying inherited or acquired hypercoagulable state can be identified. Oral contraceptive use accounts for 9% to 18% of cases in young women.

## KEY CONCEPTS

- Appendicitis is a progressive illness caused by appendiceal luminal distention followed by appendiceal wall ischemia, transmural inflammation, and eventual perforation, with resultant peritonitis.
- Clinical history, physical examination, and laboratory findings need to be combined to formulate a comprehensive assessment. No one finding can definitively diagnose or exclude appendicitis.
- The most useful historical features in evaluating appendicitis are RLQ pain, pain preceding vomiting, and migration of pain to the RLQ.
- The most useful physical findings in evaluating appendicitis are RLQ tenderness and rigidity.
- Cervical motion tenderness is not specific for pelvic pathology and is found in up to 28% of females with appendicitis.
- A rectal examination contributes little and should not be routinely performed in the evaluation of appendicitis.
- The white blood cell count alone is neither sensitive nor specific for appendicitis and offers little in the evaluation of appendicitis.
- When clinicians have a low pretest possibility for appendicitis, the combination of a WBC count below 10,000/mm<sup>3</sup> and CRP level below 8 mg/L support the exclusion of appendicitis as a likely diagnosis.
- Nonoperative management of acute appendicitis (IV antibiotics, admission) is gaining support. The patient should not have high-risk features (eg, presence of a fecalith, abscess, tumor, or fluid collection or appendiceal diameter >1.1 cm) and should be made aware of the risk of failed observation as an inpatient or recurrent appendicitis once discharged, both of which would then require surgical removal of the appendix.
- Once the diagnosis of appendicitis is made, in-hospital delay of appendectomy of up to 12 hours has not demonstrated negative outcomes when compared to emergent operative care.

## CHAPTER 83: QUESTIONS &amp; ANSWERS

**83.1.** What percentage of women with acute appendicitis have accompanying cervical motion tenderness (CMT)?

- A. 10%
- B. 15%
- C. 20%
- D. 25%
- E. 30%

**Answer: D.** Prior to the advent of routine imaging of the appendix, as many as 25% of women with acute appendicitis were initially misdiagnosed because of the presence of CMT.

**83.2.** Which of the following statements regarding ultrasonographic visualization of the appendix is true?

- A. A compressible appendix is a positive finding.
- B. An appendiceal diameter greater than 6 or 7 mm is a positive finding.
- C. The sensitivity of ultrasound for appendicitis is 94% to 98%.
- D. Ultrasonography has good reliability for detecting a retrocecal appendix.
- E. Ultrasonography compares favorably with computed tomography (CT) scanning for the detection of appendicitis.

**Answer: B.** A noncompressible appendix with a diameter greater than 6 or 7 mm in a setting of clinical appendicitis is considered a positive finding. Ultrasound sensitivities are 75% to 90%. It is a less useful modality in the obese, those with peritoneal adhesions, and those with a retrocecal appendix. The sensitivity of helical CT scanning with rectal contrast approaches 98%, much higher than ultrasonography.

**83.3.** A 27-year-old G3P2 woman at 22 weeks of gestation presents with 2 days of right lower quadrant (RLQ) abdominal pain. It began midline and later became more pronounced in the RLQ. The physical examination was remarkable for RLQ tenderness without rebound. The gynecologic examination was negative except for a nontender gravid uterus, with good fetal movement by transabdominal ultrasound. Urinalysis showed 8 to 10 white blood cells (WBCs)/high-power field (HPF) and occasional bacteria. Complete blood count (CBC) showed a WBC count of 12,700/mm<sup>3</sup> with 77% neutrophils. Hemoglobin level was 11 g/dL. RLQ ultrasound was limited, with no visualization of a normal or abnormal appendix, and transvaginal ultrasound did not show an obvious gynecologic or obstetric problem. Repeat examination showed continued RLQ tenderness. What is the most appropriate intervention?

- A. Administer cephalexin for urinary tract infection and schedule a 48-hour clinic recheck
- B. Admit for observation and serial examination
- C. Obtain surgical consultation for laparotomy
- D. Order a CT scan of the abdomen.
- E. Order a magnetic resonance imaging (MRI) scan

**Answer: E.** MRI scanning for appendicitis may be helpful in pregnant women, in whom the avoidance of radiation exposure is a significant consideration, and exploratory surgery carries additional risks.

**83.4.** In men and children with classic symptoms and signs of appendicitis, what is the most appropriate initial intervention?

- A. Antibiotics and serial abdominal examinations
- B. CT scan of the abdomen
- C. MRI scan of the abdomen
- D. Surgery
- E. Ultrasonography

**Answer: E.** In men and children with classic appendicitis, imaging adds little to the evaluation and only exposes patients to unnecessary radiation. However, it has become less and less common for a patient with a history and examination concerning for appendicitis to undergo surgery without further imaging. Ultrasound is the most appropriate initial intervention because it uses no radiation and can often visualize and diagnose appendicitis without significant delay. Graded compression ultrasound for appendicitis is specific but lacks the sensitivity of CT scan so, if the appendix is not visualized, a discussion can be had with the general surgeon to determine if it is necessary to obtain further information (via CT or MRI).

## KEY CONCEPTS

- Gastroenteritis is usually self-limited and requires supportive care only.
- Routine laboratory testing or stool cultures are not indicated for most patients.
- Caution should be used in the care of the very old and young. They have the highest morbidity and mortality in gastroenteritis.
- Hand hygiene with soap and water or hand sanitizers will contain the spread of most infectious agents in gastroenteritis.
- Patients with fever, dysentery, bloody stools, severe dehydration, a suspicion for *C. difficile*, or immunocompromised state should have a complete blood count, electrolytes, and stool cultures sent.
- Use of oral rehydration therapy (ORT) for dehydration is a preferred management strategy.
- Hypotonic oral rehydration solution is preferred (eg, WHO-modified ORT solution).
- The use of antiemetic medications may help with ORT. Ondansetron, 4 mg IV or IM, is safe and cost-effective.
- Early realimentation with normal feeding is advised and continuation of breast-feeding is suggested, if possible.
- *Campylobacter* is the most common cause of bacterial enteritis in developed countries.
- The norovirus, previously referred to as the Norwalk-like virus, is the most common cause of acute gastroenteritis in children and adults and usually occurs in the winter months.
- Bacterial pathogens cause approximately 80% of cases for traveler's diarrhea; enterotoxigenic *Escherichia coli* (ETEC) is the most common cause.
- In patients with fever or bloody stools, an antimotility agent should be given in combination with an antibiotic because it may increase the contact time of the toxin or invasive infectious agents with the intestinal mucosa.
- Classic food poisoning manifests usually 1 to 6 hours after the ingestion of preformed toxins from bacterial organisms such as *Staphylococcus*, *B. cereus*, or *C. perfringens*.
- Food poisoning is generally short-lived (24 hours), and its treatment is generally supportive care only.
- Risk factors for *C. difficile* colitis include recent antibiotic use (1–4 weeks), recent hospitalization, living in a long-term care facility, and use of antacids.
- Evaluation (colonoscopy) for toxic megacolon and pseudomembranous colitis is recommended for patients with *C. difficile* colitis who are older, have a high leukocytosis finding, appear septic, and have a tender distended abdomen. Consider empirical antibiotic treatment for suspected *C. difficile* (metronidazole, 500 mg tid for 10 days) or traveler's diarrhea (ciprofloxacin, 500 mg twice daily for 1–3 days).
- Scombroid poisoning results from eating spoiled dark meat fish; it is not an allergic reaction but results from an ingestion of histamine.
- In addition to the regular enteropathic bacterial pathogens, HIV-positive patients, particularly those with a CD4+ count <200/mm<sup>3</sup>, are more susceptible to certain viruses and parasites, such as cytomegalovirus, *Cyclospora*, *Cryptosporidium*, *Isospora*, *Mycobacterium avium-intracellulare* complex, and *Giardia*.
- In HIV-positive patients with persistent diarrhea, a small bowel biopsy and duodenal aspiration may be indicated when stool examination, cultures, and sigmoidoscopy fail to yield a definitive diagnosis.
- Consider *Giardia* for diarrhea lasting more than 2 weeks, with foul-smelling stools and symptoms of flatulence, abdominal bloating, cramping, and recent exposure to contaminated river water.

## CHAPTER 84: QUESTIONS &amp; ANSWERS

- 84.1. What is the recommended rehydration therapy for uncomplicated gastroenteritis with moderate dehydration?
- IV hydration with D<sub>5</sub> half-normal saline
  - IV hydration with normal saline
  - Oral rehydration therapy with high-osmolality fluids
  - Oral rehydration therapy with reduced-osmolality fluids
  - Oral hydration with plain water

**Answer: D.** WHO recommends oral rehydration therapy with reduced-osmolality fluids.

- 84.2. What is the most common documented cause of bacterial enteritis in developed countries?
- Campylobacter*
  - Escherichia coli*
  - Giardia*
  - Salmonella*
  - Shigella*

**Answer: A.** Most infections are acquired by eating raw or undercooked poultry meat. Symptoms of anorexia, malaise, myalgias, and headache are common, as are backaches and vomiting. Diarrhea lags 1 or 2 days after the constitutional symptoms. The syndrome can mimic appendicitis. Antibiotics are rarely needed in healthy patients. Azithromycin is first-line treatment if antibiotics are indicated.

- 84.3. Of the following choices, which is the correct association?
- Yersinia*—mesenteric adenitis, pseudoappendicitis
  - Shigella*—poultry
  - Salmonella*—warm marine environment
  - Campylobacter*—sickle cell anemia
  - Vibrio*—public swimming pools

**Answer: A.** *Yersinia*, like *Campylobacter*, may mimic acute appendicitis. The other correct associations would be *Shigella*—public swimming pools, *Salmonella*—sickle cell anemia, *Campylobacter* poultry, and *Vibrio*—warm marine water.

- 84.4. A 14-year-old boy presents with watery diarrhea that progresses to bloody diarrhea over 4 to 6 hours. He has also had moderate vomiting and significant abdominal cramping, but no other systemic symptoms. He is afebrile with a normal examination, except for diffuse, moderate abdominal tenderness to deep palpation and blood-streaked loose stool on digital rectal examination. Laboratory evaluation shows a mild leukocytosis, and the stool smear shows 12 fecal leukocytes/hpf (high-power field). Which of the following is true?
- Articular and ophthalmologic findings would be typical.
  - Ciprofloxacin is the drug of choice.
  - Endoscopy and biopsy would be the diagnostic tests of choice.
  - He is at risk of late neurologic sequelae.
  - There is likely a recent history of eating undercooked eggs.

**Answer: D.** This patient is most likely infected with enterohemorrhagic (Shiga toxin) *Escherichia coli*, which often results from eating undercooked hamburger. Watery diarrhea that becomes bloody with significant abdominal pain is typical. The diarrhea may be grossly bloody and mimic inflammatory bowel disease or intestinal ischemia. Stool cultures with specific techniques for *E. coli* are the test of choice. Toxin assays are also recommended. Endoscopic findings would be identical to those of any other severe colitis. Antibiotics are not effective and may increase the risk of hemolytic uremic syndrome in children. Thrombotic thrombocytopenic purpura (TTP) is a risk in older children and adults.



- 84.5. A 21-year-old man presents with acute onset of vomiting and retching 2 hours after eating at a restaurant. He also reports two loose stools. He is afebrile, with an unremarkable examination, except for his nausea and retching. What would be the treatment of choice?
- A. Antitoxin
  - B. Erythromycin
  - C. Fluids and antiemetics
  - D. Norfloxacin
  - E. Trimethoprim-sulfamethoxazole

**Answer: C.** Staphylococcal food poisoning presents in an acute and classic manner. Symptoms typically last 6 to 8 hours, and patients are often better before they decide to seek care. This is a toxin-mediated syndrome. Offending foods are usually eggs, potato salad, pastries, and mayonnaise. Only symptomatic treatment is necessary.

- 84.6. A 27-year-old man presents with severe abdominal cramping and diarrhea, with many frequent watery stools. He ate at a restaurant 12 hours before with two friends who have reported the same syndrome. There are no leukocytes or erythrocytes on stool examination. Which of the following statements is correct?
- A. Antibiotics may shorten symptom duration.
  - B. Fever and vomiting are typical.
  - C. Freshly cooked food is the most likely cause
  - D. Ingestion of live organisms is not required for illness.
  - E. This syndrome is usually self-limited but can progress to shock and death in rare cases.

**Answer: E.** *Clostridium perfringens* is a common source of food-borne illness. Food cooked in advance, cooled, and reheated is a typical culprit. This is a toxin-mediated, diarrhea-predominant syndrome that is almost always self-limited. Ingestion of live organisms and/or spores is required, although antibiotics are of no benefit. Symptoms usually appear within 6 to 12 hours, slightly longer than for staphylococcal food poisoning. When huge numbers of organisms are ingested, a hemorrhagic necrotizing enteritis with prostration and shock can occur.

- 84.7. A 26-year-old woman presents with a complaint of burning pain of her hands and feet. She also reports diffuse aching of her teeth. All symptoms began gradually. They were preceded the day prior by two loose stools, but her review of systems is otherwise negative. She is healthy except for a past history of anxiety, for which she takes prn lorazepam. The physical examination and vital signs are remarkable for mild ataxia. Cutaneous temperature discrimination testing is intact but unpleasant. Which of the following is the intervention of choice?
- A. IV thiamine, 100 mg
  - B. Magnetic resonance imaging (MRI) scan of the brain and lumbar puncture
  - C. Noncontrast CT scan of the brain
  - D. Psychiatric consultation
  - E. Reassurance and amitriptyline 25 mg at bedtime

**Answer: E.** Ciguatera fish poisoning is a toxin-mediated process in which gastrointestinal and neurologic symptoms (often bizarre) predominate. Cold allodynia and worsening of the dysesthesia with alcohol are diagnostic. Hyperventilation syndrome, gastroenteritis, and anxiety can be misdiagnosed.

- 84.8. A 31-year-old man with known AIDS presents with 2 weeks of profuse watery diarrhea. His only medication is trimethoprim-sulfamethoxazole bid. His last known CD4+ count was 120/mm<sup>3</sup>. The physical examination was remarkable for oral thrush and mild cachexia. He has continued to tolerate a regular diet, and his level of dehydration is minimal. What is the most appropriate intervention?
- A. Acute IV hydration, then discharge on antimotility agents
  - B. Admission for serial cultures and possible endoscopy
  - C. Combined course of ciprofloxacin and ganciclovir
  - D. Initiation of highly active antiviral therapy (HAART)
  - E. Lactose-free and low-fat dietary modifications

**Answer: B.** In cases of AIDS diarrhea, one or more enteric pathogens are found in 80% of cases. Serial stool cultures, blood cultures, and sometimes endoscopy are needed to identify the organisms and develop a treatment plan. HAART is also indicated, but not as a sole intervention. AIDS diarrhea is rarely self-limited with CD4+ counts less than 300/mm<sup>3</sup>. The most common responsible organisms are *Cytomegalovirus* and *Cryptosporidium*.

- 84.9. An 18-month-old child presents with 2 days of copious diarrhea that was preceded by 1 day of vomiting. The past history is otherwise negative except for treatment with amoxicillin for an inner ear infection 4 weeks prior. The child is moderately dehydrated by clinical examination, and there is no abdominal tenderness. The WBC count is normal. What is the most likely diagnosis?
- A. Antibiotic-associated diarrhea
  - B. *Clostridium difficile* poisoning
  - C. Norovirus
  - D. Staphylococcal food poisoning

**Answer: C.** Winter month gastroenteritis in young children is commonly norovirus, especially with the widespread use of the rotavirus vaccine. Vomiting is prominent early but rarely presents after 36 hours. There is rarely abdominal pain, fever, or leukocytosis. The diarrhea lasts 4 to 7 days and is often followed by steatorrhea. *C. difficile* may commonly present 3 or 4 weeks after antibiotic use, but vomiting is rare. Antibiotic-associated diarrhea is mild and usually occurs during the course of antibiotics.

- 84.10. A 28-year-old man presents with 2 weeks of watery, foul-smelling diarrhea and flatulence. He recently returned from a camping trip in which he participated in water rafting on a river. On examination, he appears nontoxic and afebrile, and the abdominal examination shows only diffuse cramping and bloating. What is the mostly likely causative organism?
- A. Enterotoxin-producing *Escherichia coli* (ETEC)
  - B. *Giardia*
  - C. Rotavirus
  - D. *Salmonella*
  - E. *Vibrio parahaemolyticus*

**Answer: B.** *Giardia*. Giardiasis is commonly acquired from the ingestion of contaminated water, typically a camper who has ingested river water. The symptoms include diarrhea, abdominal cramping, and bloating, with foul-smelling stools. The treatment is metronidazole, 500 mg PO bid.



## KEY CONCEPTS

### Irritable Bowel Syndrome

- IBS is a chronic disorder affecting 10% to 15% of people that presents with abdominal discomfort (bloating) associated with changes in the form or frequency of stool and is relieved by defecation.
- IBS is treated with diet, behavioral, and pharmacologic therapies.
- New or atypical symptoms in a patient with known IBS should prompt an evaluation for other abdominal pathology.

### Diverticular Disease

- Colonic diverticula are present in 10% of people older than 45 years and 80% of people older than 85 years. They can cause bleeding (diverticulosis) or become obstructed and inflamed (diverticulitis).
- Mild uncomplicated cases of diverticulitis can be diagnosed without imaging and treated in the outpatient setting with antibiotics and analgesics in many patients.
- Moderate to severe cases of diverticulitis, and most cases in older patients and immunocompromised patients, require imaging to rule out complications (eg, perforation, abscess formation) and hospitalization for treatment.

### Large Bowel Obstruction

- Over 50% of cases of LBO are caused by malignancies; other common causes include volvulus, diverticular disease, and fecal impaction.
- Gangrene or perforation should be suspected in any patient with persistent unexplained tachycardia, fever, or remarkable abdominal tenderness associated with intestinal disease.
- Over 50% of cases of LBO are caused by malignancies; other common causes include volvulus, diverticular disease, and fecal impaction.
- Gangrene or perforation should be suspected in any patient with persistent unexplained tachycardia, fever, or remarkable abdominal tenderness associated with intestinal disease.

### Volvulus

- Volvulus occurs in all age groups but is most common in older adults. It is often associated with a history of constipation, and one-third of cases involve institutionalized patients.
- It often appears as a nonspecific large bowel obstruction on plain radiographs. Abdominal CT is the diagnostic test of choice.
- Sigmoid volvulus can often be decompressed endoscopically unless gangrenous bowel is suspected clinically, whereas cecal volvulus requires surgical management.

### Intussusception

- Intussusception in adults is usually associated with a significant cause, often a malignancy.
- In adults, it usually manifests as a partial small bowel obstruction and rarely is associated with the classic triad of abdominal pain, mass, and heme-positive stool seen in children.

### Irritable Bowel Disease

- IBD includes two disorders, Crohn's disease (CD) and ulcerative colitis (UC). CD may affect any part of the gastrointestinal tract, usually the distal small intestine and proximal colon. UC affects the colon and rectum but spares the small intestine.
- IBD is a lifelong relapsing disorder that can be treated with a variety of therapies. Treatment decisions are best made in consultation with the physician who will be providing ongoing care for the patient.
- Common complications of IBD include formation of fistulae, strictures, and abscesses; less common but life-threatening complications include fulminant colitis, toxic megacolon, and intestinal perforation.
- Treatment of uncomplicated IBD depends on the clinical classification of disease severity (see [Box 85.5](#)).
- Thromboembolic events in IBD patients are often overlooked and underdiagnosed, affecting the venous and arterial systems.
- A new diagnosis of IBD in an older adult should be made only after the exclusion of colonic ischemia.

### Colonic Ischemia

- CI typically presents in older patients as the acute onset of mild crampy abdominal pain in the left lower quadrant, with abdominal distention and blood in the stool.
- The differential diagnosis includes diverticulitis, infectious colitis, and IBD.
- Although abdominal CT is not diagnostic for CI, it is useful in supporting the clinical suspicion, assessing the extent of colon involvement, diagnosing complications, and excluding other disorders.
- In the absence of surgical complications, the treatment of CI is supportive and includes bowel rest, hydration, and pain management. Broad-spectrum antibiotics covering bowel flora are indicated for patients with more significant symptoms. Surgical management is reserved for patients who have peritoneal signs and/or sepsis or fail medical therapy.

### Radiation Proctocolitis

#### Acute Radiation Proctocolitis

- Acute RP presents as abdominal and rectal pain, with diarrhea and bleeding beginning during or shortly after a course of radiation therapy. It is usually diagnosed clinically and is self-limited.
- Acute RP is treated symptomatically with steroid enemas, water-absorbing stool softeners, and often a reduction of the daily radiation dose.

#### Chronic Radiation Proctocolitis

- Chronic RP may present similarly to acute RP, but usually has a more insidious onset, with a variety of presentations based on the type of complication—stricture, obstruction, fistulae, ulceration, or bowel perforation. It usually requires endoscopy and biopsy for diagnosis.
- Chronic RP treatment depends on the presenting complication. Rectal involvement is common and can be treated with stool softeners, analgesics, antiinflammatory agents, and sucralfate enemas.

## CHAPTER 85: QUESTIONS & ANSWERS

- 85.1. Which of the following symptoms is most typical for irritable bowel syndrome (IBS)?
- A. Anorexia
  - B. Fever
  - C. Nocturnal pain
  - D. Occasional hemoccult-positive stools
  - E. Pain relieved by defecation

**Answer: E.** Pain relieved by defecation is typical for IBS. The other listed findings, along with significant abdominal tenderness, would be unusual. IBS can be constipation- or diarrhea-predominant.

- 85.2. Which of the following statements regarding diverticular disease of the colon is true?
- A. Diverticular bleeding is usually painful.
  - B. Double-contrast barium enema is the emergency department (ED) test of choice for confirmation.
  - C. It accounts for 40% of lower gastrointestinal (GI) hemorrhage
  - D. Most patients with diverticulosis develop diverticulitis.
  - E. The most common site of fistula formation is adjacent bowel.

**Answer: C.** Diverticular bleeding is typically painless. The most common site of fistula formation is the bladder. Most patients with diverticulosis remain asymptomatic. Double-contrast barium enema is the outpatient test of choice for the diagnosis of diverticulosis, but is not indicated in the acute setting.

- 85.3. A 59-year-old man with a past history of diverticulosis and diverticulitis presents with his second episode of left lower quadrant (LLQ) abdominal pain. He is afebrile, and laboratory examination is remarkable for a leukocytosis of  $13,800/\text{mm}^3$ . Physical examination reveals moderate LLQ tenderness without masses or rebound. A computed tomography (CT) scan of the abdomen reveals a small (4 cm) abscess adjacent to the sigmoid colon, with moderate diverticulosis-diverticulitis. Which of the following would be the most appropriate treatment?
- A. Admission for intravenous antibiotics
  - B. Confirmation with double-contrast barium enema
  - C. Discharge on oral antibiotics with 2-day follow-up
  - D. Radiology consultation for percutaneous drainage
  - E. Surgical consultation for laparotomy

**Answer: A.** Abscesses smaller than 5 cm are typically treated with intravenous antibiotics followed by an outpatient oral regimen. Larger abscesses may be drained surgically or percutaneously.

- 85.4. What is the most common cause of large bowel obstruction?
- A. Adhesions
  - B. Colon cancer
  - C. Diverticulitis
  - D. Intussusception
  - E. Volvulus

**Answer: B.** Colon cancer accounts for 53% of cases. Volvulus and diverticulitis account for 17% and 12% of cases, respectively. Extrinsic compression from cancer accounts for 6% of cases. Adhesions, unlike for small bowel obstructions, are a rare cause of large bowel obstructions.

- 85.5. Which of the following is a key difference between sigmoid and cecal volvulus?
- A. Clinical presentation
  - B. Incidence of constipation versus diarrhea
  - C. Incidence of spontaneous detorsion
  - D. Preferred method of detorsion
  - E. Radiographic appearance

**Answer: D.** Both types of volvulus present with acute or subacute onset of the triad of abdominal pain, distention, and constipation. Spontaneous detorsion is not typical. Sigmoid volvulus is very amenable to endoscopic detorsion, whereas cecal volvulus typically requires surgical detorsion.

- 85.6. Which of the following statements regarding intussusception is true?
- A. Bowel obstruction typically occurs.
  - B. CT scans have a high sensitivity for detection of intussusception.
  - C. Most adult cases involve the large bowel.
  - D. Most adult cases require surgery.
  - E. Most children have a causative lesion.

**Answer: D.** In contrast to children, most adult cases have a causative pathologic lesion, usually located within the small bowel. Complete obstruction occurs in less than 20% of cases. CT scans may miss as many as 50% of cases of intussusception. Surgery is usually required FOR adults with intussusception.

- 85.7. A 29-year-old woman presents with a 4-month history of intermittent abdominal pain with bloating and diarrhea. The diarrhea has been watery, nonbloody, and often nocturnal. Physical examination is remarkable for mild diffuse abdominal tenderness and brown, guaiac-positive stool. Rectal examination also demonstrates a small anal fissure at the 3-o'clock position. Laboratory evaluation is remarkable only for a normocytic anemia with a hemoglobin level of 11.5 g/dL. The diagnosis would most likely be confirmed by which of the following?
- A. Colonoscopy
  - B. CT scan of the abdomen
  - C. Erythrocyte sedimentation rate
  - D. Mesenteric angiography
  - E. Response to a high-fiber diet

**Answer: A.** This presentation is typical for inflammatory bowel disease. Nocturnal diarrhea, blood in the stool, and presence of an eccentric (nonposterior midline) anal fissure argue against IBS or a benign diarrhea. Ischemic colitis would be unlikely in this age group. Endoscopy with biopsy would be the diagnostic intervention of choice.

- 85.8. Which of the following statements regarding colonic ischemia is true?
- A. CT scanning of the abdomen is diagnostic
  - B. It is rarely associated with bloody stool.
  - C. It is typically due to nonocclusive disease.
  - D. It typically occurs without predictable antecedent events.
  - E. Specific serum biomarkers may be helpful.

**Answer: C.** Colonic ischemia is typically due to nonocclusive microvascular disease. It occurs due to low-flow conditions related to congestive heart failure (CHF), renal failure, hypovolemia, or recent illness or surgery. Bloody stools are predictable. It may also occur in younger patients with collagen vascular disease, hematologic abnormalities, or cocaine abuse. There are no sensitive or specific laboratory tests and, although sometimes suggestive, CT scanning primarily rules out other processes.

- 85.9.** Which of the following is not a diagnostic criteria for IBS?
- A. Abdominal pain of at least 3 days/month for the previous 3 months
  - B. Association of discomfort with altered stool form
  - C. Association of discomfort with altered stool frequency
  - D. Nocturnal pain
  - E. Pain relief with defecation

**Answer: D.** Night time symptoms are generally absent in irritable bowel syndrome and should prompt the provider to look for other possible causes.

- 85.10.** A 38-year-old man presents with his second episode of diverticulitis with LLQ abdominal pain and constipation. Symptoms largely resolve after hydration and conservative management in the ED. Which of the following statements is true?
- A. A high-fiber diet will exacerbate symptoms acutely.
  - B. Abdominal CT scanning should be considered.
  - C. Colonoscopy is required.
  - D. Surgical referral is indicated.
  - E. Trace occult blood would be consistent with diverticulitis.

**Answer: D.** Surgery is reserved for patients with recurrent episodes and ongoing pain.

- 85.11.** A 60-year-old woman without significant medical history presents with 3 days of LLQ pain without fever. The physical examination reveals moderate tenderness to the LLQ. No mass is felt. Pelvic and rectal examinations, including stool guaiac testing, show no abnormality. What is the most appropriate next step in this patient's management?
- A. Admit for colonoscopy.
  - B. Discharge the patient with oral antibiotics.
  - C. Obtain a CT scan of the abdomen and pelvis.
  - D. Perform an ultrasound of the pelvis.
  - E. Request urgent general surgery consultation.

**Answer: B.** Patients who are otherwise healthy, and of the appropriate age, have a good clinical examination for diverticulitis, and lack any signs of an abscess or more serious disease can be treated empirically with antibiotics as outpatients.

- 85.12.** What would be the most appropriate management strategy for the patient in question 85.11 if she were taking immunosuppressant medications for advanced rheumatoid arthritis?
- A. Admit for colonoscopy.
  - B. Discharge the patient with oral antibiotics.
  - C. Obtain a CT scan of the abdomen and pelvis.
  - D. Perform an ultrasound of the pelvis.
  - E. Request urgent general surgery consultation.

**Answer: C.** Patients taking immunosuppressant medication who present with diverticulitis may have much more serious disease than their physical examination would suggest. Such patients are at higher risk for bowel perforation by the time of presentation and should undergo more extensive evaluation to exclude complications.

- 85.13.** A patient with known ulcerative colitis presents with abdominal distention and significant dehydration. The patient appears acutely ill. A plain film of the abdomen shows a dilated segment of transverse colon measuring 8 cm in width. All of the following are indicated except:
- A. Antibiotics covering bowel flora
  - B. Intravenous corticosteroids
  - C. Intravenous rehydration
  - D. Serum chemistry measurements
  - E. Urgent colonoscopy to decompress the bowel

**Answer: E.** This patient has toxic megacolon, which does not generally have an obstructing lesion.

- 85.14.** A patient who presents with the acute onset of tenesmus and blood-streaked stool reports that he is currently undergoing pelvic radiation for prostate cancer. What is the most appropriate next step in the patient's management?
- A. Admit for colonoscopy.
  - B. Develop a care plan with the patient's radiation therapist.
  - C. Refer to a gastroenterologist for proctoscopy.
  - D. Perform anoscopy.
  - E. Send a stool sample to test for *Clostridium difficile*.

**Answer: B.** Acute radiation proctocolitis generally responds well to lowering the dose of radiation and symptomatic treatment. It generally resolves shortly after radiation treatments are completed. Those coordinating the patient's radiation treatment should be made aware of this complication.

## KEY CONCEPTS

- Anorectal conditions can be differentiated according to an algorithm (see Fig. 86.2), which addresses the presence or absence of pain, bleeding, swelling, and pruritus, in combination with an assessment of the patient's overall health.
- Patients who seek treatment for nonspecific anorectal complaints should be evaluated for the presence of underlying systemic disease (eg, cancer, diabetes mellitus, immunodeficiency) because disorders of the anus may herald the initial presentation of associated conditions.
- Patients with any STD should be evaluated for HIV infection and questioned about the use of the anus for sexual purposes and the possibility of domestic violence or abuse.
- Most anorectal conditions can be symptomatically improved by adherence to the WASH regimen (**w**arm water, **a**nalgesics, **s**tool softeners, **h**igh-fiber diet).
- Thrombosed external hemorrhoids are covered by modified anoderm and may be excised and drained within 48 hours.
- Internal hemorrhoids are covered with mucosa and should be referred to colorectal surgeon for definitive management.
- Acutely thrombosed, gangrenous fourth-degree internal hemorrhoids should be referred urgently to a surgeon.
- Superficial abscesses may be drained in the ED.
- Fistulous tracts should not be probed.
- Pilonidal abscesses should be drained with needle aspiration or a longitudinal incision off the midline.
- Pruritus ani is caused by a variety of conditions, including infection, topical irritants, cutaneous conditions, cancer, and hypersensitivity to foods and drugs (see Box 86.5).
- Sensitivity is required when managing patients with anorectal foreign bodies. Health care provider safety is imperative when evaluating foreign bodies with sharp edges.
- Distal foreign bodies often can be removed in the ED using creative means, whereas proximal or sharp ones should be removed under general anesthesia in the operating room.

## CHAPTER 86: QUESTIONS &amp; ANSWERS

- 86.1.** Which of the following statements regarding hemorrhoids is true?
- Most hemorrhoidal bleeding is venous.
  - Painful bleeding is the most common symptom.
  - Portal hypertension does not cause hemorrhoids in adults.
  - Seventy-five percent of pregnant women experience late-pregnancy hemorrhoids.
  - Traumatic deliveries do not predispose to postpartum hemorrhoids.

**Answer: C.** Portal hypertension does not predispose to hemorrhoids, except in children. Bleeding in these cases is likely from rectal varices. Most hemorrhoidal bleeding is from the superior rectal artery and thus is bright red. Approximately one-third of pregnant patients experience hemorrhoids in the third trimester or postpartum period. Traumatic deliveries can result in hemorrhoid development. Painless bleeding with defecation is the most common symptom (pain usually occurs if hemorrhoids are thrombosed).

- 86.2.** What is the most common cause of sudden-onset rectal pain?
- Anal fissure
  - Proctalgia fugax
  - Sacral radiculopathy
  - Thrombosed external hemorrhoid
  - Thrombosed internal hemorrhoid

**Answer: A.** Anal fissures typically result from superficial tears in the anoderm, usually occurring in the posterior midline. The pain is heightened by secondary spasm of the anal sphincter.

- 86.3.** When performing an incision and drainage of a pilonidal cyst, which of the following is the most appropriate method?
- Elliptic incision
  - Horizontal incision at the center of the affected area
  - Horizontal incision at the lower portion of the affected area

- Longitudinal incision along the midline
- Longitudinal incision lateral to the midline

**Answer: E.** Making a longitudinal incision lateral to the midline spares the area that is most vulnerable to reaccumulation of debris and the inflammatory response. Removal of pus, inflammatory tissue, and ingrown hairs relieves the pain of the abscess and promotes healing.

- 86.4.** A 68-year-old woman presents with hemorrhoids. On examination, you note three protruding masses that are maroon in color and may be reduced manually into the anorectal opening. What is the most appropriate curative therapy?
- Application of a concentrated sucrose solution to the affected area
  - Emergent surgical intervention (eg, banding, sclerosing, hemorrhoidectomy)
  - Prescription of a 7-day course of topical corticosteroid cream
  - Referral to a surgeon for an outpatient procedure
  - Removal of the hemorrhoid with an elliptic incision, including overlying tissue

**Answer: D.** Third-degree internal hemorrhoids may be manually reduced in the emergency department (ED) but are unlikely to heal spontaneously. Referral for operative therapy is curative. Excision of internal hemorrhoids is contraindicated. Acutely thrombosed external hemorrhoids may be excised in the ED. Temporizing measures include using the WASH regimen—using warm water to encourage reduction of the protruded hemorrhoids, maintaining hygiene, analgesics, stool softeners to ease passage of stool, and a high-fiber diet. Topical corticosteroids may be used for 1 or 2 days during an acute exacerbation, but their continued use promotes skin breakdown and itching. A sucrose solution may prove helpful in reducing procidentia (rectal prolapse). A thorough history should be obtained and a physical examination performed to learn if an underlying medical condition may be associated with the hemorrhoids.



## KEY CONCEPTS

- The causes of AKI can be classified as prerenal, postrenal, and intrinsic renal disorders. Abrupt cessation of glomerular filtration typically results in a rise of the serum creatinine level of 1 to 2 mg/dL per day.
- Management of AKI is directed first at potentially lethal complications such as hyperkalemia or volume overload and then at reversal of the underlying cause of renal dysfunction. It is important to avoid any further hemodynamic or toxic insults to the kidneys.
- Patients with acute or chronic kidney disease have a limited ability to handle fluid and solute loads and have altered metabolism of many drugs. Therefore, the patient's impaired renal function must be considered when fluid is administered or drugs are prescribed.
- The most rapidly lethal complication of acute and chronic kidney disease is hyperkalemia.
- The most common problems with vascular access devices used for hemodialysis are thrombosis, hemorrhage, and infection. Access infection often presents as fever without an obvious source and, in this case, appropriate IV antibiotics should be administered presumptively while awaiting blood culture results.
- Peritoneal dialysis—associated peritonitis typically presents with cloudiness of the peritoneal dialysis effluent. The diagnosis is made by a positive Gram stain or finding of more than 100 WBC/mm<sup>3</sup> in the effluent, with at least 50% polys. It is generally treated on an outpatient basis with intraperitoneal antibiotics self-administered by the patient.
- Chest pain in the dialysis patient should be presumed initially to be due to acute coronary syndrome, although other potentially serious causes may also be responsible. Serum troponin levels tend to be elevated in patients with poor renal function, but patients with myocardial infarction show the typical temporal pattern of rise and fall of troponin levels.
- Hypotension in CKD patients is often caused by infection, but may also be the result of rapid fluid removal during dialysis. This often responds readily to fluid administration. Pericardial tamponade is another cause of hypotension that should be considered for these patients.
- Altered mental status is most commonly due to causes similar to those seen in patients without renal disease, but is sometimes the result of overrapid shifts in intravascular fluid and solutes during dialysis, termed *disequilibrium syndrome*.

## CHAPTER 87: QUESTIONS &amp; ANSWERS

87.1. Of the following choices, which is the correct match between type of urine cast and pathologic condition?

- Fatty casts—glomerulonephritis
- Granular casts—renal parenchymal infection
- Hyaline casts—dehydration, exercise
- Red cell casts—nephrotic syndrome
- White cell casts—acute tubular necrosis (ATN)

**Answer: C.** Hyaline casts are associated with dehydration, exercise, and glomerular proteinuria. The following are the other correct associations:

- Fatty casts—nephrotic syndrome
- Red cell casts—glomerulonephritis
- White cell casts—renal parenchymal infection
- Granular casts—ATN

87.2. A 34-year-old man with chronic kidney disease has missed his last two hemodialysis treatments and presents with generalized fatigue and dyspnea on exertion. Vital signs include a blood pressure of 165/94 mm Hg, but are otherwise normal. Room air  $\text{Sao}_2$  is 94% at rest. A portable chest x-ray shows vascular congestion. Which of the following is an indication for immediate dialysis?

- Blood urea nitrogen (BUN) level of 87 mg/dL and serum creatinine level of 10.6 mg/dL
- Serum calcium level of 6.8 mg/dL and serum albumin level of 3.0 g/dL
- Serum potassium level of 7.6 mEq/L (not hemolyzed)
- Serum sodium level of 124 mEq/L
- Serum troponin level of 0.08 ng/mL

**Answer: C.** Severe hyperkalemia is an indication for immediate dialysis in this patient. An ECG should be obtained stat to determine the degree of cardiotoxicity, and immediate medical treatment for hyperkalemia should be given while awaiting initiation of dialysis. Abnormalities of the serum sodium or calcium level can generally be treated without hemodialysis. A minimal troponin level elevation may be seen in patients with chronic kidney disease, but does not generally require specific treatment without other signs of cardiac ischemia; dialysis is not required.

87.3. What is the most common cause of nontraumatic hematuria?

- Carcinoma of the kidney or bladder
- Cystitis
- Kidney stones
- Prostatic hyperplasia
- Transfusion reaction

**Answer: C.** In descending frequency, the most common causes are kidney stones, lower urinary tract infection (UTI), benign prostatic hypertrophy (BPH), carcinoma of the kidney or bladder, urethritis, and glomerulonephritis.

87.4. A 53-year-old man presents with painless gross hematuria.

His only past medical history is an aortic valve replacement for which he takes warfarin. The physical examination is nonfocal. Laboratory evaluation is remarkable for a normal chemistry panel and blood count, too numerous to count (TNTC) red blood cells (RBCs) on urinalysis, and international normalized ratio (INR) of 1.8. What is the next indicated step?

- Admission and observation
- Parenteral vitamin K
- Reassurance
- Renal imaging
- Withholding warfarin (Coumadin) for 3 days

**Answer: D.** When hematuria is associated with anticoagulant use, underlying disease can be identified in a significant proportion of patients.

87.5. A 33-year-old woman presents with mild nonfocal abdominal pain and subjective fever. Her past medical history is significant for hypertension-induced renal failure, for which she is on peritoneal dialysis (PD). The physical examination is remarkable for a temperature of 38°C (100.4°F), blood pressure 190/110 mm Hg, and mild nonfocal abdominal pain. Slightly cloudy peritoneal fluid is aspirated from the PD catheter and sent for analysis. Which of the following statements regarding this patient's condition is correct?

- A peritoneal fluid white blood cell (WBC) count >50/mm<sup>3</sup> is diagnostic.
- Intravenous antibiotics should be started empirically.
- Most cases are due to *Staphylococcus*.
- No organism is identified in 50% of cases.
- Polymicrobial infections suggest sample contamination.

**Answer: C.** Most PD-associated cases of peritonitis are due to *Staphylococcus aureus* or *Staphylococcus epidermidis*. No organism is identified in 20% of cases. A polymicrobial infection warrants GI evaluation for possible perforation or intra-abdominal abscess. A PD fluid count >100 cells/mm<sup>3</sup>, with a neutrophil count >50% or positive Gram stain, is considered confirmatory. Treatment is typically with intraperitoneal antibiotics given for a 10- to 14-day course.



## KEY CONCEPTS

- The ED diagnosis of STDs is often based on clinical findings. Empirical antibiotic treatment is warranted to cover the most likely infecting organisms based upon history and physical examination findings. Rapidly available diagnostic tests (Gram stain, darkfield microscopy, wet mount microscopy, and others) increase diagnostic sensitivity and specificity.
- Confirmatory diagnostic studies (PCR, culture, serology, and others) should be considered even when results are not immediately available. A mechanism for follow-up of test results should be established and appropriate patient contact information obtained.
- STDs frequently coexist. Diagnosis of one STD should prompt consideration and screening for others, including HIV.
- Infection with any STD increases the risk of acquisition and transmission of HIV.
- Genital herpes, the most common ulcerating STD, is often transmitted by persons who are unaware that they are infected or are asymptomatic at the time of transmission.
- Nontreponemal serologic screening tests (VDRL, RPR) may yield false-positive or false-negative results in a patient with a genital ulcer and suspected syphilis.
- In a patient with a genital ulcer, visualization of spirochetes on darkfield microscopy is highly specific for the diagnosis of syphilis and provides rapid confirmatory results.
- Single-dose antibiotic therapy should be used for treatment of STDs when possible. Directly observed therapy administered in the ED enhances treatment compliance.
  - A single dose of azithromycin 1 g PO will treat chlamydia causing lower genitourinary tract infection (urethritis, cervicitis) but is inadequate for treatment of upper tract infection (PID, epididymo-orchitis).
  - A single dose of ceftriaxone 250 mg IM will treat gonorrhea causing both upper and lower genitourinary tract infection in men and women.
  - A single dose of long-acting benzathine penicillin G (2.4 million units IM) will treat primary and secondary syphilis.
  - A single dose of metronidazole 2 g PO is the treatment of choice for symptomatic trichomoniasis during all stages of pregnancy.
- Single-dose antibiotic therapy is inadequate for the treatment of PID.
- HIV, syphilis, gonorrhea, chlamydia, and chancroid are reportable diseases in all 50 of the United States.

## CHAPTER 88: QUESTIONS &amp; ANSWERS

**88.1.** A 30-year-old pregnant female presents for evaluation of a genital ulcer. Darkfield microscopy reveals spirochetes. She is allergic to penicillin. Which of the following statements is *false*?

- Azithromycin is an acceptable treatment alternative for primary syphilis during pregnancy in a patient with known penicillin allergy.
- Nontreponemal serologic tests for syphilis (rapid plasma reagin [RPR], Venereal Disease Research Laboratory [VDRL]) may yield false negative results in primary syphilis.
- Primary syphilis facilitates the transmission and acquisition of human immunodeficiency virus (HIV) infection.
- Syphilis is a reportable disease in all 50 states.
- The chancre of primary syphilis will heal spontaneously without antibiotic therapy.

**Answer: A.** Penicillin remains the drug of choice for treatment of syphilis during pregnancy. A pregnant patient with syphilis and known penicillin allergy should be admitted for desensitization and treatment with penicillin. Nontreponemal serologic tests may yield false negative results in primary syphilis when antibody titers have not yet risen. False positive serology may be seen with a variety of other medical conditions. Visualization of spirochetes on darkfield microscopy confirms the diagnosis of syphilis. All sexually transmitted diseases (STDs) facilitate the transmission and acquisition of HIV. Reportable STDs in all 50 states include gonorrhea, chlamydia, syphilis, HIV, and chancroid.

**88.2.** A 17-year-old female presents with complaints of pelvic pain. She reports multiple sexual partners and inconsistent condom use. Pelvic examination reveals yellow cervical discharge, cervical motion tenderness, and bilateral adnexal tenderness. Pregnancy test is negative. Which of the following statements regarding this scenario is correct?

- All adolescents with pelvic inflammatory disease require hospital admission for intravenous antibiotics.
- A negative nucleic acid amplification test for gonorrhea and chlamydia reliably excludes the diagnosis of pelvic inflammatory disease.
- In the absence of an identifiable alternative diagnosis, the clinical diagnosis and empirical treatment of pelvic inflammatory disease is warranted.
- The clinical diagnosis of pelvic inflammatory disease requires the presence lower abdominal tenderness *and* cervical motion tenderness *and* adnexal tenderness on physical examination.

**E.** Women treated as outpatients for pelvic inflammatory disease should have a follow up evaluation in 2 weeks.

**Answer: C.** The clinical diagnosis of pelvic inflammatory disease is warranted in a sexually active woman at risk for sexually transmitted diseases (STDs) if no alternative diagnosis is identified and any one of the following findings is present on examination: (1) cervical motion tenderness, (2) uterine tenderness, and/or (3) adnexal tenderness. Additional diagnostic criteria (mucopurulent cervical discharge, fever, elevated white blood count, positive testing for gonorrhea or chlamydia, and others) improve specificity but decrease sensitivity in the diagnosis of pelvic inflammatory disease (PID). Adolescents with PID may be treated as outpatients using the same criteria as adult women. Women receiving outpatient treatment for PID should be advised to seek a follow up evaluation within 48 to 72 hours.

**88.3.** A previously healthy 22-year-old female is diagnosed with pelvic inflammatory disease (PID). Pregnancy test is negative. She is well-perfused and nontoxic in appearance. She is tolerating oral intake without difficulty. She has no known drug allergies. Which of the following antibiotic regimens is acceptable for outpatient treatment of pelvic inflammatory disease?

- Azithromycin 1 g *per os* (by mouth) (PO) (single dose) *and* metronidazole 500 mg bid for 14 days.
- Ceftriaxone 125 mg IM (single dose) *and* doxycycline 100 mg bid for 7 days.
- Ceftriaxone 250 mg IM (single dose) *and* azithromycin 1 g PO (single dose).
- Ceftriaxone 250 mg IM (single dose) *and* doxycycline 100 mg PO bid for 14 days.
- Metronidazole 2 g PO (single dose) *and* doxycycline 100 mg PO bid for 14 days.

**Answer: D.** Pelvic inflammatory disease is typically a polymicrobial infection. *Neisseria gonorrhoeae* and/or *Chlamydia trachomatis* are frequently implicated organisms, but anaerobes, enteric organisms, and normal vaginal flora may also be present. Empirical treatment of PID should include adequate coverage for gonorrhea and chlamydia. A single dose of ceftriaxone 250 mg IM is adequate treatment for upper tract gonococcal infection. A 14-day course of antibiotics is recommended for adequate chlamydia coverage in PID. The addition of anaerobic coverage, such as metronidazole, should be considered.

- 88.4.** A 24-year-old sexually active male presents with painful genital ulcers. Physical examination reveals a cluster of 2 to 3 mm tender superficial ulcers on the penile shaft. He reports a history of similar lesions in the same location sporadically in the past. Which statement regarding this clinical scenario is *false*?
- A. Both herpes simplex virus (HSV)-1 and HSV-2 can be transmitted through sexual contact.
  - B. Genital herpes is a lifelong viral infection.
  - C. Prompt initiation of antiviral medication reduces the duration and severity of symptoms.
  - D. Topical antiviral therapy is not recommended.
  - E. Use of condoms is not necessary to prevent transmission in the absence of clinically apparent lesions.

**Answer: E.** Genital herpes is a lifelong infection caused by herpes simplex virus. Sexual transmission is more common with HSV-2 but may also occur with HSV-1. Condom use is recommended during asymptomatic periods, because viral shedding and transmission may occur even in the absence of clinically apparent lesions. Antiviral therapy is not curative. Prompt initiation of systemic antiviral medication within 72 hours (acyclovir, famciclovir, or valacyclovir) reduces the duration and severity of symptoms, particularly at the time of primary infection. Topical antiviral therapy is not recommended.

- 88.5.** A 24-year-old female presents to the emergency department (ED) complaining of vaginal discharge. A copious frothy whitish discharge is noted on speculum examination. Microscopic examination of a saline wet mount reveals motile flagellated organisms. Which of the following statements is correct?
- A. Metronidazole is the drug of choice for treatment of symptomatic trichomoniasis during all stages of pregnancy.
  - B. Punctate hemorrhagic lesions are seen on the cervix in most cases of trichomonas vaginitis.

- C. Tinidazole is a safe alternative for treatment of trichomoniasis during pregnancy.
- D. Trichomoniasis is always symptomatic in men and women.
- E. Wet mount microscopy approaches 100% sensitivity in the diagnosis of trichomonas vaginitis.

**Answer: A.** Metronidazole is the drug of choice for treatment of symptomatic trichomoniasis during all stages of pregnancy. Tinidazole should be avoided in pregnant women due to limited data regarding safety for use in pregnancy. Visualization of flagellated protozoans on wet mount microscopy of vaginal discharge is highly specific, but only 50% to 65% sensitive for the diagnosis of trichomoniasis. Punctate hemorrhagic lesions on the cervix (so called "strawberry cervix") is seen in up to 10% of cases. Nucleic acid amplification tests for trichomonas are highly sensitive and specific. Trichomoniasis may be asymptomatic in men and women.

- 88.6.** Which of the following sexually transmitted diseases (STDs) can be treated with single-dose antibiotic therapy administered in the emergency department (ED)?
- A. Chancroid
  - B. Primary and secondary syphilis
  - C. Trichomoniasis
  - D. Urethritis caused by gonorrhea or chlamydia
  - E. All of the above

**Answer: E.** Single-dose antibiotic therapy is efficacious for many STDs, including gonococcal urethritis and cervicitis, primary and secondary syphilis, trichomoniasis, and chancroid. Single-dose azithromycin is recommended for coverage of lower genitourinary tract infection with chlamydia. Treatment of upper genitourinary tract STDs, including pelvic inflammatory disease and epididymo-orchitis, requires a longer course of antibiotic therapy. Directly observed therapy administered in the ED promotes compliance.

## KEY CONCEPTS

- Urinary obstruction should be ruled out in patients with a urinary tract infection (UTI) and those in septic shock.
- Acute, uncomplicated urinary tract infections should be treated with fosfomycin, nitrofurantoin, or trimethoprim-sulfamethoxazole.
- Fluoroquinolones are not recommended as first-line therapy for uncomplicated UTI.
- The three primary predictors of stone passage without the need for surgical intervention are calculus size, location, and degree of patient pain. The most important factor that relates to passage of a calculus through the genitourinary tract is its size (stone  $<5$  mm has a 90% chance of passing spontaneously in 4 weeks).
- Imaging is not needed in all patients with renal colic. If the signs and symptoms are atypical, the diagnosis is in question, the patient has a solitary or transplanted kidney, or appears toxic, or high-grade obstruction is suspected, imaging should be performed.
- Acute scrotal pain should be considered a result of testicular torsion until proven otherwise.
- There is no single history or physical examination finding that accurately or reliably differentiates torsion from other causative disorders. Any patient with acute onset of scrotal pain in whom the diagnosis of torsion cannot be ruled out should undergo further diagnostic testing.
- Rapid diagnosis of testicular torsion is essential and should be followed by emergent surgical scrotal exploration and bilateral orchiopexy, if necessary. Loss of the testicle usually is a result of delay in seeking medical attention.
- Scrotal pain or swelling after trauma warrants a scrotal ultrasound to evaluate for testicular rupture or torsion.
- Sexually active males should receive ceftriaxone and doxycycline to treat epididymitis. Patients in whom enteric organisms are likely the cause of epididymitis should receive fluoroquinolones. Most cases of pediatric epididymitis are idiopathic, and antibiotics are not routinely recommended.
- Acute urinary retention (AUR) is usually caused by an obstructive lesion but also can be the presenting manifestation of other pathologic processes.
- Patients with AUR and concomitant infection, pelvic mass, or neurologic deficits warrant imaging in the ED.
- Patients with AUR should have complete drainage of the bladder performed via catheterization or, if this is not possible, by suprapubic aspiration. To improve the likelihood of future spontaneous voiding in men, an  $\alpha$ -adrenergic blocker such as tamsulosin should be given at the time of insertion.
- Most cases of microscopic hematuria are transient and idiopathic, but also can arise with infection, trauma, and exercise.

## CHAPTER 89: QUESTIONS &amp; ANSWERS

**89.1.** Which of the following drugs is not an appropriate first-line choice for treatment of an uncomplicated urinary tract infection (UTI) in women?

- A. All of these
- B. Ciprofloxacin
- C. Fosfomycin
- D. Nitrofurantoin
- E. Trimethoprim-sulfamethoxazole

**Answer: B.** According to the Infectious Disease Society of America (IDSA) practice guidelines, fluoroquinolones should not be used as first-line agents for uncomplicated UTI because of increased resistance.

**89.2.** Which of the following clinical scenarios is not an indication for emergent imaging of the genitourinary tract?

- A. 3-year-old girl with first episode of urinary tract infection (UTI)
- B. 31-year-old woman with clinical pyelonephritis and normal urinalysis (UA)
- C. 34-year-old man with classic renal colic
- D. Pyelonephritis and fever more than 72 hours after antibiotic initiation
- E. UTI in the patient with diminishing renal function

**Answer: C.** Other indications for imaging include a patient with renal colic and suspicion of obstruction and a female patient with multiple complex infections.

**89.3.** Which of the following antibiotics should be avoided during the first trimester of pregnancy?

- A. All of these
- B. Ciprofloxacin
- C. Levofloxacin
- D. Nitrofurantoin
- E. Trimethoprim-sulfamethoxazole

**Answer: A.** Nitrofurantoin is associated with fetal malformations when used in the first trimester. Trimethoprim-sulfamethoxazole is associated with teratogenicity. In general, fluoroquinolones should not be used during pregnancy due to developmental toxic ity risks.

**89.4.** All of the following are acceptable antibiotic choices for the treatment of pyelonephritis except?

- A. Ceftriaxone
- B. Ciprofloxacin
- C. Levofloxacin
- D. Nitrofurantoin
- E. Trimethoprim-sulfamethoxazole

**Answer: D.** Nitrofurantoin does not achieve therapeutic levels in the renal parenchyma and is therefore not effective for pyelonephritis.

**89.5.** Which of the following differentiates testicular torsion from other causes of a painful scrotum?

- A. Blunt trauma to the testicle
- B. Pyuria on urinalysis
- C. Nighttime presentation
- D. None of the above

**Answer: D.** There is no single history or physical examination finding that accurately or reliably differentiates torsion from other causative disorders. Any patient with acute onset of scrotal pain in whom the diagnosis of torsion cannot be ruled out should undergo further diagnostic testing.

**89.6.** A testis will tend to rotate laterally to medially in most cases of torsion. To detorse in these situations, you should rotate the testis medially to laterally. If this does not produce immediate relief, you should do which of the following?

- A. Assume that the testicle is already necrotic and not amenable to further reduction attempts.
- B. Attempt untwisting past 360 degrees because a higher degree of rotation may be present.
- C. Both A and B.
- D. Reverse the direction of reduction.

**Answer: D.** Most testes torse laterally to medially, but some may torse medially to laterally. If no immediate relief is obtained by rotating medially to laterally, reverse the direction of the reduction attempt.

**89.7.** Computed tomography should be undertaken in the patient suspected of having renal colic if which of the following is present?

- A. The patient has a solitary or transplanted kidney.
- B. The patient has gross hematuria.
- C. The patient has had a prior history of nephrolithiasis.
- D. The patient presents in severe pain.

**Answer: A.** Imaging is appropriate for patients who have a history of nephrolithiasis who do not improve with treatment, have a urinalysis showing infection, have a solitary or transplanted kidney, or for whom a diagnosis other than renal colic is suspected.

**89.8.** What is the most common cause of acute urinary retention seen in the ED?

- A. Infection, inflammation
- B. Obstruction
- C. Medications
- D. Neurogenic disorder

**Answer: B.** Obstruction. The most common cause of AUR seen in the ED is obstruction of the urinary tract distal to the bladder (primarily benign prostatic hypertrophy).

**89.9.** Acute bacterial prostatitis is diagnosed by which of the following?

- A. History and examination
- B. Serum studies
- C. Transrectal ultrasound or CT
- D. Urine gram staining and culture
- E. Urethral swab

**Answer: A.** Acute bacterial prostatitis can be diagnosed clinically; urine gram staining and culture are recommended to guide treatment.

## KEY CONCEPTS

- Ovarian torsion is easily missed on initial presentation, and diagnosis cannot rely on radiologic findings alone. Doppler ultrasound is the optimal imaging study; absence of arterial flow, although not always present, is highly specific for torsion. Torsion should be a consideration in any patient with known risk factors, even if symptoms are subtle or atypical.
- An ultrasound examination may distinguish among the various types of ovarian cysts and identify associated complications, such as torsion, hemorrhage, and malignancy. Most ovarian cysts are simple follicular cysts that resolve without pharmacologic or surgical intervention.
- Abnormal uterine bleeding has many structural, hormonal, and coagulopathic causes. Selected imaging and laboratory testing, based on a careful history and physical examination, can often lead to determination of the cause. Combined oral contraceptive pills can help regulate the cycle and alleviate AUB.
- Emergency contraception is a safe effective option to prevent an undesired pregnancy. Levonorgestrel and ulipristal are both effective oral medications and are associated with fewer side effects than the traditional combined contraceptive method.

## CHAPTER 90: QUESTIONS &amp; ANSWERS

**90.1.** Which of the following statements regarding ovarian torsion is true?

- A. Abdominal tenderness is predictable.
- B. Complete arterial obstruction is common.
- C. Computed tomography (CT) has a higher sensitivity than ultrasound.
- D. Most cases are associated with an ovarian mass.
- E. There is a left-sided predominance.

**Answer: D.** Most cases are associated with a benign ovarian tumor or cyst. There is a modest right-sided predominance. Due to the collateral uterine and ovarian arterial supply, complete arterial obstruction is rare. In cases of intermittent or chronic torsion particularly, abdominal tenderness may be absent. CT has a lower sensitivity than ultrasound, which is still only approximately 71%. Interpret negative studies carefully.

**90.2.** Which of the following patterns of menses should be considered abnormal?

- A. A 23-day menstrual cycle
- B. A 40-day menstrual cycle
- C. Bleeding 6 months after menopause
- D. Seven days of menstrual flow
- E. Three days of menstrual flow

**Answer: B.** A menstrual cycle shorter than 21 days or more than 35 days apart, or flow that is less than 2 days or more than 7 days, is considered abnormal. In the postmenopausal woman, any bleeding 12 months after cessation of menses is considered abnormal.

**90.3.** A 33-year-old G3P3 woman presents with 7 days of heavy but painless vaginal bleeding. Her only other complaint is dizziness. Urine pregnancy test is negative. Vital signs are blood pressure, 85/40 mm Hg, and heart rate, 130 beats/min. The pelvic examination reveals copious vaginal bleeding through a partially open cervical os. The hemoglobin level is 6.8 g/dL. Which of the following is the most appropriate intervention?

- A. 20 µg of ethinyl estradiol daily until the bleeding subsides
- B. 35 µg ethinyl estradiol bid until the bleeding subsides
- C. Blood transfusion and urgent gynecologic consultation for dilation and curettage
- D. Premarin, 25 mg IV every 6 hours
- E. Saline hydration followed by a 2-day recheck

**Answer: C.** This patient is symptomatic, hypovolemic, anemic, and exhibiting ongoing bleeding. Oral estrogens are indicated in cases of modest bleeding. Parenteral estrogen may be used as an adjunct to other therapies for patients requiring admission. The degree of anemia in the face of ongoing bleeding in this case warrants gynecologic intervention.

**90.4.** To be most effective, the emergency contraceptive ulipristal should be given as soon as possible but is approved to be given within how many hours of intercourse?

- A. 12
- B. 24
- C. 48
- D. 72
- E. 120

**Answer: E.** The efficacy of all emergency contraceptive pills in preventing pregnancy is greatest when a contraceptive is taken soon after intercourse. Ulipristal is labeled for 120 hours post-coitus. Because it is not as effective as preplanned contraception, women should still be aware of the possibility of pregnancy after its use.



## KEY CONCEPTS

- Anterior circulation strokes result in contralateral hemiparesis of the face and body.
- Vertebrobasilar strokes result in ipsilateral CN deficits and contralateral hemiparesis.
- Posterior cerebral artery stroke causes ipsilateral CN III palsy and contralateral homonymous hemianopsia.
- Wallenberg's syndrome (lateral medullary syndrome) causes vertigo, Horner's syndrome, ipsilateral facial numbness, loss of corneal reflex, and contralateral loss of pain/temperature.
- Cervical artery dissection is a common cause of stroke in young patients; TIAs preceding stroke in these patients are often missed.
- The goal for eligible patients is to receive thrombolytics within 90 minutes of symptoms onset; the dose of alteplase is 0.9 mg per kg with 10% given as a bolus and the remaining 90% given over 1 hour.
- Acute ischemic stroke patients receiving alteplase are at risk of developing a spontaneous intracranial hemorrhage; the risk is lowest in patients with a low stroke score, no hypertension, no diabetes, and age younger than 70.
- In acute ischemic stroke, the patient and or their families should be informed of the risk and benefit of treatment with alteplase.
- Patients with a hemorrhagic stroke on coumadin should *be promptly reversed* using vitamin K and either FFP or PCC.
- Prognosis is worse in acute stroke in the setting of fever, hypotension, hypoxia, and hyperglycemia.
- Carotid Doppler, MRA, or CTA studies are recommended before discharge of a patient with TIA from the ED.
- Overly aggressive BP management should be avoided in patients with acute ischemic stroke.
- Accurate identification of the last time a patient was known to be at his or her neurologic baseline should be documented in all patients with stroke.
- IV alteplase followed by endovascular thrombectomy is recommended in patients with large anterior circulation artery occlusion.

## CHAPTER 91: QUESTIONS &amp; ANSWERS

**91.1.** Which of the following statements concerning ischemic stroke is true?

- A.** Anterior circulation strokes are more likely than posterior strokes to show evidence of progression at the time of presentation.
- B.** Anterior circulation strokes rarely present with complete loss of consciousness.
- C.** Posterior cerebral artery strokes are associated with incontinence, leg weakness greater than arm weakness, and gait clumsiness.
- D.** The presence of aphasia suggests an anterior cerebral artery (ACA) distribution stroke, typically left sided.
- E.** The presence of diplopia suggests an anterior circulation stroke.

**Answer: B.** Forty percent of posterior and 20% of anterior circulation strokes present with progressive symptoms. It is rare for anterior circulation (carotid, ACA, and middle cerebral artery [MCA]) strokes to significantly alter consciousness, unless there

has been a previous contralateral stroke. ACA strokes primarily affect frontal lobe functions and may also present with primitive grasp and such reflexes. In addition to contralateral motor and sensory defects, MCA strokes may present with expressive aphasia, agnosia, and ipsilateral hemianopsia.

**91.2.** Which of the following is not associated with posterior circulation strokes?

- A.** Diplopia
- B.** Homonymous cranial nerve (CN) and extremity motor deficits
- C.** Loss of consciousness
- D.** Loss of visual object recognition
- E.** Nausea, vomiting, and ataxia

**Answer: B.** Posterior circulation (vertebrobasilar) strokes involve the vertebral, basilar, and posterior cerebral arteries. Because this system supplies the reticular activating system, cerebellum, brainstem, occipital lobe, and brainstem vomiting centers, loss of consciousness with vomiting, visual changes, and cerebral ataxia may be seen. Ipsilateral CN deficits (because these nuclei largely reside in the brainstem) occur with contralateral “body” deficits resulting from motor/sensory fiber decussation.

- 91.3. Headache, vomiting, and a decreased level of consciousness are most commonly seen with which of the following disorders?
- A. Ischemic stroke
  - B. Intracranial hemorrhage
  - C. Migraine headache
  - D. Subarachnoid hemorrhage (SAH)
  - E. Tic douloureux

**Answer: D.** The incidence of headache is highest by far in patients with SAH. Vomiting and depressed loss of consciousness are also generally more common in this group. Pure migraine headache rarely, if ever, causes a depressed loss of consciousness. Tic headaches do not cause loss of consciousness.

- 91.4. What percentage of patients with hemorrhagic stroke experience clinical deterioration because of growth in hemorrhage volume within the first hours?
- A. 10%
  - B. 20%
  - C. 30%
  - D. 50%
  - E. 75%

**Answer: C.** Thirty percent of patients with intracerebral hemorrhage (ICH) experience early hemorrhage expansion. Progression of neurologic deficits and decreasing mental status suggest the diagnosis.

- 91.5. A 69-year-old male presents with headache, vomiting, aphasia, a right lower facial palsy, and right upper greater than right lower extremity weakness. The symptoms began approximately 4 hours before arrival. Vital signs are temperature 99° C, blood pressure (BP) 180/90 mm Hg, respiratory rate 18 breaths per minute, heart rate 92 beats per minute, and oxygen saturation 96% on room air. Emergent computed tomography (CT) scan shows a left temporal intracerebral hemorrhage (ICH). Soon after presentation, the patient experiences increased vomiting and a diminishing level of consciousness. What is the most likely explanation for this deterioration?
- A. Accompanying subarachnoid hemorrhage (SAH)
  - B. Acute brainstem herniation
  - C. Hypoxia from neurogenic pulmonary edema
  - D. Increase in volume of the ICH
  - E. Myocardial infarction with cardiogenic shock

**Answer: D.** Approximately one-third of patients with ICH experience early hemorrhage volume expansion. Although brainstem herniation is a possibility, this is typically a later sequelae with a more gradual presentation. Acute myocardial infarction may be associated with intracranial emergencies but would not likely cause an abrupt mental status change. Neurogenic pulmonary edema may accompany any condition with elevated intracranial pressure (ICP) but, again, would not likely cause an abrupt mental status change.

- 91.6. After complete occlusion of cerebral vessels, irreversible neurologic deficits are expected to reliably occur within how many hours?
- A. 2
  - B. 3
  - C. 4
  - D. 5
  - E. 6

**Answer: E.** Thus ischemic stroke trials, using fibrinolytic or antiplatelet agents, have attempted to recanalize occluded arteries and reperfuse ischemic areas of the brain within a 2- to 6-hour therapeutic window.

- 91.7. Which of the following areas of the brain is perfused by the posterior circulation?
- A. Internal capsule
  - B. Posterior aspect of the temporal lobe
  - C. Putamen
  - D. Speech areas of the temporal lobe
  - E. Thalamus

**Answer: E.** The thalamus is perfused by the posterior circulation. The other areas are perfused by the anterior circulation.

- 91.8. Which of the following statements regarding stroke etiology is true?
- A. Lacunar strokes reliably cause a pure motor deficit.
  - B. Less than 1% of strokes occur in the 15- to 45-year-old age group.
  - C. One-third of ischemic strokes are thrombotic.
  - D. Strokes resulting from atrial fibrillation likely involve small vessels.
  - E. Two-thirds of ischemic strokes are cardioembolic.

**Answer: C.** One-third of ischemic strokes are thrombotic. Lacunar strokes may cause a pure motor, pure sensory, or ataxic/hemiparesis stroke. Vessel occlusion resulting from atrial fibrillation-induced emboli more likely involves the large vessels. Three percent to 4% of ischemic strokes occur in the 15- to 45-year-old age group.

- 91.9. A 29-year-old female presents with a left-sided headache after a moderate-speed motor vehicle collision (MVC). She suffered no loss of consciousness and has no other complaints or obvious injuries. Physical examination is remarkable only for drooping of the left eyelid and slight miosis of the left pupil compared with the right. Which of the following would be the diagnostic test of choice?
- A. Brain magnetic resonance imaging (MRI) with gadolinium
  - B. Contrasted computed tomography (CT) scan of the brain
  - C. CT angiogram of the carotid arteries
  - D. Uncontrasted CT scan of the brain
  - E. Urine drug screen

**Answer: C.** Carotid or vertebral artery dissection can occur after trauma or mild events, such as yoga, twisting, or prolonged static positions looking upward. The hallmark is unilateral neck pain, face pain, or headache, often with accompanying Horner's syndrome. Acutely, cerebral ischemic changes would not be seen on brain imaging. Carotid and vertebral dissection is not a contraindication for thrombolytic therapy in the eligible patient.

- 91.10. What percentage of patients who experience a transient ischemic attack (TIA) will develop a stroke within 3 months?
- A. 5%
  - B. 10%
  - C. 15%
  - D. 20%
  - E. 25%

**Answer: B.** One-tenth of them will occur within 2 days of the sentinel event.

**91.11.** A 28-year-old G3P3 woman who is 2-weeks postpartum after an uncomplicated vaginal delivery presents with acute onset of mild headache, lethargy, and double vision. Physical examination is remarkable for normal vital signs and a left eye lateral gaze palsy. The most appropriate intervention is likely to be which of the following?

- A. Computed tomography (CT) scan of the brain with possible lumbar puncture
- B. CT scan of the brain and intravenous (IV) heparin
- C. Erythrocyte sedimentation rate (ESR) and IV corticosteroids
- D. IV magnesium
- E. Lumbar puncture and IV antibiotics

**Answer: B.** Cerebral venous thrombosis may present with headache, lethargy, cranial nerve (CN) deficits, seizures, or even psychiatric complaints. CT scan and/or magnetic resonance imaging (MRI)/magnetic resonance angiography (MRA) are likely to reveal the diagnosis. Treatment includes heparin. Neurosurgical consultation is not useful. Subarachnoid hemorrhage (SAH) would not be expected to cause a focal neurologic deficit. Eclampsia and meningitis would be expected to give characteristic findings on history and examination.

**91.12.** Which of the following statements is true regarding management of acute ischemic stroke?

- A. Heparin is indicated for patients in whom thrombolysis is not an option.
- B. If the initial computed tomography (CT) scan shows a large left middle cerebral artery (MCA) distribution stroke but no hemorrhage, thrombolysis would be indicated.
- C. Initial blood pressure (BP) greater than 185/110 mm Hg would contraindicate thrombolytic treatment.
- D. Mechanical thrombectomy may be indicated up to 6 hours after stroke onset.
- E. No clot retrieval devices have been U.S. Food and Drug Administration (FDA) approved for acute ischemic stroke management.

**Answer: D.** Intra-arterial thrombolysis may offer benefit up to 6 hours past stroke onset. BPs higher than 185/110 mm Hg are not an absolute contraindication to thrombolysis if they can be lowered to this level with one or two doses of a parenteral agent, such as labetalol or enalapril. The Mechanical Embolus Removal in Cerebral Ischemia (MERCI) retrieval device was FDA approved in 2004, and several newer stent-retriever devices have been approved since then. In recent trials of thrombectomy, improved outcomes were demonstrated at least to 6 hours; and outcomes were even better when patients received reperfusion within 4.5 hours of onset. Aspirin has a proven benefit in patients who do not receive tissue plasminogen activator (tPA). There is no proven benefit to heparin, although some practitioners use it in cases at high risk of stroke progression.

**91.13.** An 82-year-old male presents with an apparent stroke. He is rapidly evaluated and determined to be within the 3- to 4.5-hour window for fibrinolytic therapy. Which of the following exclusion criteria applies only to the 3- to 4.5-hour criteria and not the 0- to 3-hour criteria?

- A. Administration of heparin within the 48 hours preceding the stroke onset
- B. Age older than 80 years
- C. High clinical suspicion for subarachnoid hemorrhage (SAH)

D. Seizure at the onset of the stroke

E. Symptoms rapidly improving

**Answer: B.** In the 3- to 4.5-hour window, patients cannot exceed 80 years of age. Heparin administration within the 48 hours preceding stroke onset is a contraindication in both the 0- to 3-hour window as well as the 3- to 4.5-hour window. Similarly, high clinical suspicion for SAH, seizure at the onset of the stroke symptoms, and rapidly improving symptoms are contraindications to fibrinolysis in both time windows.

**91.14.** A 66-year-old female presents with a possible transient ischemic attack (TIA). Approximately 1 hour before her arrival, she had a 15-minute episode of strictly right arm and right leg weakness, and her symptoms have now resolved. Her blood pressure (BP) is 165/92 mm Hg. Her prior medical history is significant for hypertension, high cholesterol, and diabetes mellitus. What is her ABCD2 score?

- A. 4
- B. 5
- C. 6
- D. 7
- E. 8

**Answer: C.** The patient's ABCD2 score is 6 (age >60 years, BP >140/90 mm Hg, unilateral weakness, symptoms lasting 10 to 59 minutes, and history of diabetes). No speech impairment is reported.

**91.15.** A 72-year-old male presents with an apparent stroke. Computed tomography (CT) imaging of the brain demonstrates only a hyperdense middle cerebral artery (MCA) sign and no other ischemic changes. He was last seen neurologically normal 4 hours earlier. Which of the following is a contraindication to fibrinolytic therapy in this patient?

- A. His blood glucose is 372 mg/dL.
- B. His National Institutes of Health (NIH) Stroke Scale score is 24.
- C. His platelet count is 110,000/mm<sup>3</sup>.
- D. His systolic blood pressure (BP) is 180 mm Hg.
- E. He takes warfarin daily.

**Answer: E.** Any oral anticoagulant treatment (regardless of the patient's international normalized ratio [INR]) is a contraindication to fibrinolysis in the 3- to 4.5-hour treatment window. Other contraindications include an NIH stroke scale score greater than 25, platelet count less than 100,000/mm<sup>3</sup>, blood glucose greater than 400 mg/dL, and systolic BP greater than 185 mm Hg.

**91.16.** A 75-year-old man is brought to the emergency department (ED) for altered mental status. After computed tomography (CT) imaging of the brain is performed, he is found to have a large intracerebral hemorrhage (ICH). Which of the following options is *not* an appropriate strategy for lowering intracranial pressure (ICP)?

- A. Barbiturate-induced coma
- B. Hyperthermia induction
- C. Hypertonic saline administration
- D. Hyperventilation
- E. Mannitol administration

**Answer: B.** Hypothermia is an experimental modality for lower ICP. Hyperventilation can serve as a temporizing measure for reducing ICP. Mannitol and/or hypertonic saline can also be administered. Inducing a barbiturate coma is also an experimental modality.

## KEY CONCEPTS

- Seizures can be provoked by many acute processes, including infections, toxins, cardiac dysrhythmias, and CNS insults.
- Epilepsy is a condition of recurrent, *unprovoked* seizures.
- Partial seizures are confined to one hemisphere of the brain and have clinical manifestations reflecting the area of electrical activity. Generalized seizures involve both hemispheres and always involve alterations in consciousness.
- There is no single test to confirm that a patient seized, and a number of seizure mimics including convulsive syncope exist. A post-ictal alteration in mental status makes a seizure five times more likely than syncope.
- Although most seizures are self-limited, management of the seizure patient involves a targeted search for underlying pathology, treatment of sequelae of seizures when necessary, and prevention of future episodes.
- Stroke is a leading cause of new seizure in elders.
- Noncompliance with antiepileptic medication is the most common cause of ED presentation for recurrent seizures.
- During a seizure, the patient should be placed in the left lateral decubitus position when possible. Suctioning may help prevent aspiration, but intraoral devices will cause trauma without yielding significant benefit.
- A patient with new-onset seizures who returns to baseline mental status and does not have comorbid disease does not require diagnostic testing beyond serum glucose and sodium levels, a pregnancy test (in women), and a non-contrast head CT.
- Non-convulsive status epilepticus should be considered in any patient with prolonged, unexplained altered mental status.
- For patients with a first-time seizure and without a clear CNS disease or lesion, evidence does not support initiation of antiepileptic drugs in the ED.
- Alcohol dependence places patients at risk of seizures in a number of ways, and alcohol-withdrawal seizures should only be diagnosed after excluding other causes. These seizures, as well as seizures due to other drugs of abuse, respond to benzodiazepines but not to traditional antiepileptic medications.
- Antiepileptic medications have been shown to reduce post-traumatic seizures in the first week after injury but not beyond that.
- In pregnant patients, evaluations for new-onset seizures prior to 20 weeks should be the same as in nonpregnant patients. After 20 weeks, eclampsia is a major cause of seizures and is treated with magnesium.

## CHAPTER 92: QUESTIONS &amp; ANSWERS

- 92.1. Which of the following statement regarding the pathophysiology of seizures is *true*?
- A. During a seizure, prompt loss of consciousness implies a cortical focus.
  - B. Generalized seizures involve abnormal electrical activity in one hemisphere.
  - C. Regarding seizure activity, acetylcholine is inhibitory.
  - D. Regarding seizure activity, gamma-aminobutyric acid (GABA) is excitatory.
  - E. The clinical seizure activity typically reflects the brain focus of initiation.

**Answer: E.** Clinical seizure activity typically reflects the site of seizure origin. Generalized seizures involve both brain hemispheres. Acetylcholine is an excitatory neurotransmitter, and GABA is inhibitory. Prompt loss of consciousness with a seizure implies a subcortical focus involving the reticular activating system.

- 92.2. Which of the following statements regarding epilepsy is *true*?
- A. Electrolyte disturbances are the most common cause of recurrent seizures in epileptic patients.
  - B. Epilepsy is a condition of recurrent provoked seizures.
  - C. Epileptic seizures are always generalized tonic-clonic.
  - D. Epileptic seizures can be triggered by smells or lack of sleep.
  - E. Most adult-onset epilepsy does not have an identifiable cause.

**Answer: D.** Epilepsy is a condition of recurrent, *unprovoked* seizures. Idiopathic epilepsy almost always starts in childhood. Medication noncompliance is the most common cause of recurrent seizures in epileptic patients. Epileptic seizures can be partial seizures. Some patients with epilepsy have seizures triggered by certain specific sensory stimuli, with flashing lights being the most well-known of these.

- 92.3. Which of the following factors does not put patients at risk for seizures?
- A. Acute stroke
  - B. Chronic stroke-related lesions
  - C. Hyperkalemia
  - D. Hypomagnesemia
  - E. Indwelling intracranial shunts

**Answer: C.** Indwelling intracranial shunts and other lesions, and hypomagnesemia (as seen in malnourished alcohol-dependent patients) are all risk factors for seizures. Stroke is one of the most common causes of seizures in the elderly. Seizures occurring acutely with a stroke are often partial and reflect the affected brain area, whereas those that occur chronically are often generalized. Hyperkalemia does not cause seizures unless it precipitates hypotension and consequent hypoperfusion of the brain.

- 92.4. Which of the following statements regarding patients presenting with first-time seizures is *true*?
- A. All patients should have basic serum electrolyte testing.
  - B. All patients should receive a loading dose of an antiepileptic drug and a prescription for an oral regimen prior to discharge.
  - C. Non-contrast head computed tomography (CT) is not indicated for most afebrile patients.
  - D. Non-diabetic patients do not need to have serum glucose checked if their mental status returns to normal.
  - E. Persistent altered mental status is an indication for a lumbar puncture.

**Answer: E.** Persistent altered mental status should trigger consideration of a lumbar puncture, serum glucose and an electroencephalogram (EEG) among other testing. Non-contrast CT of the head is relatively high-yield in first time seizure patients, and most guidelines recommend performing one. Patients with no comorbidities who return to baseline mental status do not need broad-based electrolyte testing, but hypoglycemia is a common cause of seizures even in non-diabetic patients and should be routinely tested for in first-time seizure patients. Initiation of antiepileptic drugs in the emergency department (ED) for first-time seizure patients without a known structural brain lesion may do more harm than good.



- 92.5. Which of the following statements regarding post-traumatic seizures is *true*?
- A. Adults are more likely to present with status epilepticus.
  - B. Antiepileptic drugs are effective in preventing late post-traumatic seizures.
  - C. Immediate and early post-traumatic seizures are more common in adults.
  - D. Most occur immediately following the traumatic injury.
  - E. The severity of head injury correlates with the likelihood of post-traumatic seizures.

**Answer: E.** The severity of head injury correlates directly with the likelihood of post-traumatic seizures. The incidence of seizures is higher when the dura is violated. Children are more likely to have immediate or early (<1 week) seizures and to present in status. Antiepileptic drugs do not affect the incidence of late post-traumatic seizures (>1 week).

- 92.6. For which of the following causes of seizure are alcohol-dependent patients not at increased risk?
- A. Electrolyte disturbances
  - B. Head trauma
  - C. Toxin-induced (other than alcohol)
  - D. Uremia
  - E. Withdrawal

**Answer: D.** Alcoholic-dependent patients frequently fall or otherwise sustain head trauma during periods of intoxication. Alcohol withdrawal is associated with a high incidence of seizure. Alcohol intoxication can be associated with co-ingestion of illicit drugs, which also cause seizures. Chronic alcohol dependence can be associated with malnutrition causing hypomagnesemia.

- 92.7. Which of the following regarding seizures from illicit drug use is *true*?
- A. Benzodiazepines are contraindicated in cessation of these seizures.
  - B. K2 ("spice") has not yet been reported to cause seizures.
  - C. Marijuana use is strongly associated with seizures.
  - D. *N*-methyl-3,4-methylenedioxymphetamine (MDMA) compounds, such as ecstasy, may induce seizures via hyperthermia.
  - E. Phenytoin is the first-line treatment.

**Answer: D.** Seizures from cocaine, MDMA compounds and other drugs are notoriously unresponsive to traditional antiepileptic agents, and benzodiazepines are considered the first line of treatment. Marijuana is generally not associated with seizures, although synthetic cannabinoids, such as K2, have been. Ecstasy and other MDMA compounds inhibit sweating and can cause seizures by inducing hyperthermia.

- 92.8. A 23-year-old woman is brought to the emergency department (ED) for a prolonged seizure. By emergency medical service (EMS) report, the patient has no past medical history and no history of seizures. Paramedics report tonic-clonic activity for approximately 15 minutes, refractory to diazepam 5 mg intravenously in the ambulance. Upon arrival to the ED, the patient's seizure activity abruptly ceases, and she lucidly responds to the history and physical examination. She is symptom free. What would be the most appropriate intervention?
- A. A trial of oral phenytoin after an intravenous (IV) loading dose in the ED
  - B. Computed tomography (CT) scan of the head followed by lumbar puncture
  - C. Confrontation
  - D. Neurology referral for electroencephalogram (EEG) and consultation
  - E. Psychiatric consultation

**Answer: D.** No clinical criteria are 100% specific for the diagnosis of pseudoseizures. Seizures and pseudoseizures may coexist. For many patients, these episodes may not be deliberate. The most prudent course of action would be to treat them as possible ictus and refer to a neurologist. Initiation of antiepileptic drugs in the ED is not indicated in first-time seizures of healthy patients who return to normal.



## KEY CONCEPTS

- The goals of headache evaluation in the ED are (1) to distinguish between benign primary headache disorders and potentially life-threatening secondary causes of headache and (2) to treat the headache pain effectively and rapidly without causing undue side-effects.
- Patients with the following headache presentations are at risk for serious underlying disease: sudden explosive headache; first or "worst-ever" headache; new-onset headache after the age of 50 years; headache associated with papilledema, alteration in or loss of consciousness, or focal neurologic symptoms; subacute headache with increasing frequency or severity; headache associated with fever, cancer, or immunosuppression; and headache triggered by exertion, sexual activity, or Valsalva maneuver.
- The need for diagnostic studies is dictated by the suspected secondary cause of headache.
- Sumatriptan medications are the first line therapy for migraine headaches.
- Patients with migraine treated in the ED need to be discharged with a "rescue plan" if the headache reoccurs.
- High-flow oxygen will terminate the majority of cluster headaches.
- Opioids are not first line treatment for primary headaches and are reserved for cases refractory to other interventions.
- The differential diagnosis of sudden severe headache includes SAH, CVT, CAD, and IIH.
- CVT should be suspected in women who have a new type of headache and are pregnant or on birth control pills.
- Carotid artery dissection may result in headache, ptosis, and miosis.
- Patients suspected of having a PTHA should be evaluated for a CN IV or VI neurapraxia and for cervical strain as a cause of their headache.

## CHAPTER 93: QUESTIONS &amp; ANSWERS

- 93.1. Which of the following mechanisms is least likely to play a role in the pathophysiology of migraine headaches?
- Cortical spreading depression
  - Pathologic cerebrovascular dilation activates surrounding afferent nerve endings, causing typical pulsating pain
  - Sensitization of higher-order nociceptive centers in the brainstem and thalamus
  - Sterile neuropeptide induced inflammatory process
  - Trigeminal nerve activation

**Answer: B.** Trigeminovascular activation, possibly triggered by cortical spreading depression or a sterile neurogenic inflammation, causes activation and sensitization of higher-order nociceptive centers in the brainstem and thalamus. A primary vascular etiology of migraine pain is not supported by available evidence.

- 93.2. A 42-year-old male presents with the acute onset of a left-sided headache. He had one similar headache approximately 1 year ago that lasted 3 hours, subsided rapidly, and like this one, was associated with alcohol intake. Physical examination is remarkable for an obviously uncomfortable healthy male pacing and rubbing his left temple. You note left conjunctival injection with tearing. What should be the next step?
- Computed tomography (CT) scan
  - Dexamethasone 10 mg intravenously
  - High-flow oxygen by face mask
  - Measurement of intraocular pressure
  - Morphine 10 mg intravenously

**Answer: C.** Cluster headaches occur predominantly in men, occur suddenly, and often abate quickly. These headaches are typically unilateral and characterized by a sharp stabbing ocular pain that may be accompanied by a "conjunctivitis" picture, a partial Horner's syndrome, or unilateral nasal congestion. Alcohol may precipitate. Standard antimigraine agents may be helpful (eg, sumatriptan, antiemetics), but high-flow oxygen is highly effective and very well tolerated. Calcium channel blockers and corticosteroids are useful for preventing subsequent attacks of cluster headache. As with migraines, opioids should be reserved for refractory pain.

- 93.3. A 29-year-old female presents within 1 hour of the sudden onset of a severe, diffuse headache accompanied by meningismus and vomiting. Emergent computed tomography (CT) scan is negative. Lumbar puncture (LP) reveal 50,000 red blood cells (RBCs) in tube 1 and 30,000 RBCs in tube 4. Opening pressures are normal, and the sample is negative for xanthochromia. What would be the most appropriate next step?
- Admission and observation
  - Cerebrovascular imaging study
  - Hydration, analgesics

- Magnetic resonance imaging (MRI) scan with gadolinium
- Subcutaneous sumatriptan 6 mg

**Answer: B.** CT scan provides a sensitivity of approximately 90% for the detection of subarachnoid hemorrhage (SAH). A traumatic LP, even with diminishing RBC counts with sequential tubes, cannot differentiate between a SAH and traumatic tap. The lack of xanthochromia is predictable, given the acute onset of headache and the 12 hours required for cerebrospinal fluid (CSF) xanthochromia to develop. A cerebrovascular imaging study, such as computed tomography angiography (CTA), magnetic resonance angiography (MRA), or standard angiography would be required next to exclude a source of bleeding, such as an aneurysm or arteriovenous malformation (AVM).

- 93.4. A 69-year-old male presents with several months of intermittent left-sided headaches that have been worse at night and occasionally on exposure to cold air. On several occasions, he has noted increased pain while eating. He has had no other symptoms other than modest fatigue. Physical examination is unremarkable with normal vital signs and ophthalmologic and neurologic survey. Laboratory evaluation shows only a mild anemia, with a hemoglobin of 11 mg/dL and normocytic indices. What would be the most appropriate next step?
- Computed tomography (CT) scan of the brain
  - Electrocardiogram
  - Erythrocyte sedimentation rate (ESR)
  - Neurology consultation
  - Ophthalmology consultation

**Answer: C.** Temporal arteritis may present with intermittent or continuous symptoms, sometimes associated with fatigue, myalgias, jaw claudication, and mild anemia. The ESR is usually, but not always, diagnostic and would confirm the diagnosis if elevated. Steroids and ophthalmology consultation would then follow. The presence of temporal artery tenderness may be variable because the vasculitis may affect any artery. The diagnosis must be suspected in any elderly patient with recurrent or continuous headaches.

- 93.5. With cavernous sinus thrombosis, the clinical picture is usually dominated by which of the following?
- Facial pain
  - Lethargy
  - Nausea and vomiting
  - Ocular findings such as pain and proptosis
  - Seizures

**Answer: D.** The symptoms may also include paralysis of extraocular movements. Ocular symptoms are most common with thrombosis of the cavernous sinus, rather than one of the other sinuses.

## KEY CONCEPTS

- Delirium is an acute condition characterized by an altered level of consciousness, disorganized thinking, and inattention. It develops during a short time, and symptoms tend to fluctuate during hours to days.
- Delirium is commonly caused by medications, drug intoxication or withdrawal, infections, metabolic disorders, CNS and cardiovascular events, and autonomic nervous system disturbances.
- Dementia is a chronic condition characterized by cognitive impairment. It is slow in onset and progressive in nature. This disorder has many causes, some of which are reversible with treatment. It is essential to search for reversible underlying etiologies that may be worsening a cognitive impairment.
- Patients with either dementia or psychiatric disorders may present with superimposed delirium, often making identification of the underlying cause of their abnormal behavior difficult.
- The clinician should be wary of attributing behavioral disturbances to psychiatric illness in the presence of abnormal vital signs or abnormal sensorium.
- Nonpharmacologic methods including behavioral methods and avoidance of environmental triggers should be considered in the treatment of agitation in patients with dementia.
- Antipsychotics and benzodiazepines are used cautiously, in the management of acute agitation in delirium and dementia. The choice of agent is determined by side effect profile and etiology of delirium or acute agitation.
- Antipsychotics and benzodiazepines are not approved for the long-term treatment of the behavioral symptoms of dementia.
- Antipsychotics may cause QTc prolongation and increased mortality especially when given intravenously.
- Lower doses of medications may be appropriate in older adults to decrease risk of adverse effects while effectively treating acute agitation.

## CHAPTER 94: QUESTIONS &amp; ANSWERS

**94.1.** Which of the following characteristics helps distinguish dementia from delirium?

- A. Autonomic nervous system derangements
- B. Cranial nerve dysfunction
- C. Disorientation
- D. Focal weakness
- E. Pain

**Answer A.** Delirium is characterized by a disturbance in level of consciousness with confusion. Demented patients present with a much more gradual onset of symptoms with typically no change in level of consciousness. Delirium is further characterized by autonomic nervous system abnormalities and the presence of an underlying disease process. The disturbance also tends to fluctuate in severity during the course of the day.

**94.2.** A 78-year-old woman presents with 3 days of decreasing ability to concentrate, memory and cognition breakdown, sleep cycle disruption, and fluctuating levels of agitation. Her current medications include levofloxacin (Levaquin) 500 mg/day for a bladder infection, tramadol prn for knee arthritis, and hydrochlorothiazide 25 mg/day for essential hypertension. Her examination is normal except for a baseline tachycardia, moderate agitation and restlessness, and orientation to person only. Laboratory analysis shows glucose 198 mg/dL, sodium 131 mEq/L, potassium 3.8 mEq/L, creatinine 1.4 mg/dL, white blood cell (WBC) count 11,300 cells/mm<sup>3</sup>, hemoglobin 12 g/dL, bicarbonate 25 mEq/L, and a normal urinalysis. What is the most likely etiology for her delirium?

- A. Early sepsis
- B. Hyperglycemia
- C. Hyponatremia
- D. Intracranial hemorrhage
- E. Medication effect

**Answer: E.** Medications are the most common cause of delirium in the older adult population. Common inciting medications include antibiotics (quinolones and macrolides), analgesics, sympathomimetics, antiinflammatories, sedatives, and cardiovascular agents. This level of hyponatremia would not be expected to cause a delirium. Likewise, a modest hyperglycemia without associated acidosis would be an unlikely culprit.

**94.3.** An 82-year-old man presents with acute delirium. On examination, he is alert and mildly agitated. He is oriented to person and place but not time. He is easily distracted and exhibits a mild bilateral upper extremity resting tremor without asterixis. His neurologic examination is nonfocal. His short-term memory is impaired. What is the

central component most key to the diagnosis of delirium in this case?

- A. Agitation
- B. Disorientation
- C. Inattention
- D. Memory dysfunction
- E. Tremor

**Answer: C.** Disturbance in attention is central to the diagnosis of delirium. Disorientation often accompanies this but is not invariably present. The patient is usually disoriented to time and, less often, place. The delirious patient may also experience visual, auditory, tactile, and olfactory hallucinations; may lose the ability to modulate emotional expression; and often exhibits fluctuating symptoms. Short-term memory is usually impaired, but this is also seen in dementia.

**94.4.** Which of the following associations is correct?

- A. Droperidol: QT prolongation
- B. Haloperidol: Dysphoria
- C. Lorazepam Excessive half-life
- D. Meperidine: Cholinergic effects
- E. Phenothiazines: Hypocalcemia

**Answer: A.** This may also be seen, although less so, with haloperidol and the phenothiazines. Meperidine causes dysphoria and possibly some anticholinergic effects. Diazepam results in the longest terminal  $T_{1/2}$  of the benzodiazepines.

**94.5.** A 63-year-old man presents with acute-onset delirium. He is a known alcoholic, and the family reports a cessation of alcohol intake 36 hours before presentation. He has no other known medical problems. Examination is remarkable for an acutely delirious patient who has active visual and auditory hallucinations and a mild tremor. Neurologic examination is otherwise negative, except for a left sixth cranial palsy. Finger-stick glucose is normal. Thiamine 100 mg intravenously fails to improve his symptoms. Which of the following is the intervention most likely to immediately improve his function?

- A. Dextrose
- B. Haloperidol
- C. Lorazepam
- D. Magnesium
- E. More thiamine

**Answer: D.** Magnesium is a cofactor in the utilization of thiamine. In chronically magnesium-depleted patients, Wernicke's encephalopathy may be refractory to thiamine until magnesium is also administered.

## KEY CONCEPTS

**Trigeminal Neuralgia**

- Patients with unilateral, intermittent, lancinating facial pain without abnormalities on physical examination are likely to have trigeminal neuralgia.
- Carbamazepine starting at 100 mg bid is the first-line agent for medical treatment, with a typical therapeutic dose of 600 to 800 mg/day in divided doses.
- Patients who do not tolerate treatment or whose pain is refractory to medical management may be candidates for microvascular decompression or ablation.

**Facial Nerve Paralysis**

- Patients who have facial muscle paresis with intact forehead movement should be considered to have a central (upper motor neuron) lesion until the diagnostic investigation proves otherwise.
- Slowly progressive or recurrent facial paralysis is suggestive of a neoplasm. Recurrent unilateral paralysis may occur with Bell's palsy but frequently (30%) is seen in patients with tumor.
- Simultaneous bilateral facial paralysis is suggestive of Lyme disease, especially in endemic regions.
- Patients with Bell's palsy should be treated early in the course with corticosteroids, prednisolone at 50 mg/day for 10 days. Antiviral medication, valacyclovir, 1000 mg orally three times daily for 7 days, or famciclovir, 750 mg orally for 7 days should be considered in patients with severe loss of function.

**Vestibular Schwannoma**

- The onset of unilateral auditory symptoms, especially sensorineural hearing loss, requires evaluation and referral to an ear, nose, and throat specialist.
- Neurologic symptoms of lower CN dysfunction, ataxia, or raised ICP may be caused by a benign tumor at the cerebellopontine angle.

**Diabetic Cranial Mononeuropathy**

- Diabetic neuropathy is a diagnosis of exclusion because no definitive diagnostic testing is available, although a CN III palsy with sparing of

the pupillary response in a patient with a history of diabetes is classic for the presentation.

- Both ischemic and hemorrhagic brainstem lesions must be ruled out in the case of an acute ophthalmoplegia.
- Extraocular mononeuropathy is sufficiently common in patients with diabetes mellitus that its occurrence in isolation warrants evaluation of the patient for previously undiagnosed diabetes.

**Cerebral Venous Thrombosis**

- The differential diagnosis for CVT includes other conditions that present with new-onset neurologic deficits, alteration in consciousness, or severe headache. CVT is more likely to be present in these patients when the etiology is unclear, the patient is thought to have a hypercoagulable state, and the head CT is normal in appearance or shows subtle signs of CVT.
- Non-contrast-enhanced CT scanning is not adequate to rule out CVT. MRI with MRV is recommended, although multidetector row CT venography is an acceptable alternative.
- Treatment of most patients with CVT includes systemic anticoagulation, even in the setting of hemorrhagic cerebral infarcts, unless another contraindication exists.

**Multiple Sclerosis**

- MS should be suspected in patients who present with episodes of neurologic dysfunction that evolve over days and resolve over weeks.
- Apparent exacerbations of known MS can be brought on by other medical problems, most commonly infections.
- Therapy for patients with MS will require consultation with the patient's primary care provider or neurologist to provide consistent disease management.
- IV methylprednisolone, 250 to 500 mg every 12 hours for 3 to 7 days effectively promotes earlier resolution of recurrences.
- IV methylprednisolone has been shown to speed the recovery from vision loss from optic neuritis associated with MS.

## CHAPTER 95: QUESTIONS &amp; ANSWERS

- 95.1.** A 53-year-old woman presents with complaints of increasing left facial pain. She describes a pattern of brief, excruciatingly painful lancinating sensations along the left jaw associated with chewing and brushing her teeth. She notes intermittent clusters of pain that last seconds to a minute and have not occurred at night. Physical examination is normal except for triggered left jaw and buccal pain with palpation of the left mandibular area. What is the most likely finding in this patient?
- Analgesia from a left inferior alveolar nerve block
  - Analgesia from subcutaneous sumatriptan
  - Immediate pain relief with high-flow oxygen
  - Magnetic resonance imaging (MRI) evidence of multiple sclerosis (MS)
  - Vascular compression of the trigeminal nucleus

**Answer: E.** In 80% to 90% of cases of trigeminal neuralgia, a vascular compression of the trigeminal nucleus is found in series of surgical cases. Microvascular decompression of the trigeminal nerve is curative in a high percentage of patients who fail to respond to medical management. Approximately 5% of patients with trigeminal neuralgia have MS. Cluster headache and migraine treatments are not effective. Peripheral nerve block is also ineffective because the pathologic process is more central at the nucleus.

- 95.2.** A 26-year-old man presents with complaints of left facial drooping. The symptoms began painlessly 3 days ago without a prodrome. Examination reveals a left facial droop with an inability to wrinkle the forehead without other associated physical examination abnormalities. Which of the following will provide the largest potential benefit to the patient's recovery?
- High-volume lumbar puncture
  - Initiation of oral antiviral treatments
  - Initiation of oral corticosteroids
  - Intravenous (IV) thrombolysis
  - Urgent non-contrast-enhanced computed tomography (CT) scan of the head

**Answer: C.** The patient has Bell's palsy, which is a painless left facial nerve palsy. The primary symptom is a left peripheral nerve paralysis often with unilateral dysgeusia, hyperacusis (stapedius muscle paralysis), and external canal and pharyngeal numbness. Facial sensation is intact. Corticosteroids are helpful, and they should be initiated as far out as a week after onset, although they should be started within 24 hours if possible. Initiation of oral antiviral treatment has shown benefit in some trials, although conflicting evidence exists. In the absence of a contraindication and in a patient who can afford the medicine, antivirals should be considered. Given the classic picture and lack of other associated neurologic findings, CT scan of the head is not required and is not likely to provide benefit. Testing for Lyme disease is indicated in Lyme endemic areas or in patients with a history of a tick bite.

**95.3.** A 43-year-old woman presents with her fourth episode of left facial paralysis in 1 year. She denies prodrome or associated symptoms. Examination is consistent with an isolated left peripheral facial nerve paralysis. What should be the next step in her management?

- A. Antinuclear antibody level and erythrocyte sedimentation rate
- B. Carotid angiography
- C. Initiation of antivirals and corticosteroids
- D. Magnetic resonance imaging (MRI) scan
- E. Neurology referral

**Answer: D.** A neoplastic cause should be suspected in patients who suffer from recurrent facial paralysis, significant pain, prolonged symptoms, or any associated cranial nerve (CN) dysfunction.

**95.4.** Which of the following statements regarding acoustic neuroma is *true*?

- A. An audiogram has a sensitivity of greater than 95%.
- B. Gadolinium-enhanced magnetic resonance imaging (MRI) is the diagnostic test of choice.
- C. Symptom onset is generally during 1 to 3 months.
- D. Symptoms of increased intracranial pressure (ICP) are common.
- E. The symptoms of Ménière's disease are essentially identical.

**Answer: B.** Computed tomography (CT) lacks the posterior fossa sensitivity to detect small tumors. Although asymmetrical hearing loss is the hallmark of this disease, audiograms may be normal in up to 15% of cases. Symptom onset is generally during years rather than months. Although increased ICP can happen, it is uncommon. The tinnitus of Ménière's disease is typically intermittent rather than continuous.

**95.5.** Which of the following symptoms is not associated with diabetic cranial mononeuropathy?

- A. Diplopia
- B. Inability to move the eye inferolaterally
- C. Nonreactive pupil
- D. Orbital pain
- E. Ptosis

**Answer: C.** Diabetic cranial mononeuropathy may affect the third, fourth, or sixth cranial nerve (CN). Pain, diplopia, and ptosis are common. Pupillary reactivity is usually preserved because these fibers are on the third nerve periphery and less affected by the occlusion of the "penetrating" neural nutrient artery affecting the core motor fibers. Inferolateral movement paralysis may be seen with a fourth nerve palsy and lateral paralysis with a sixth nerve palsy.

**95.6.** A 64-year-old diabetic woman presents with the acute onset of painless diplopia. She has a 25-year history of type 2 diabetes. Her only other past history is hypertension. Physical examination reveals normal vital signs and a normal neurologic examination with the exception of an inability to look laterally with the left eye. What is the most appropriate next step?

- A. Cerebral angiography
- B. Contrast-enhanced computed tomography (CT) scan
- C. Magnetic resonance imaging (MRI) scan
- D. Ophthalmology consultation
- E. Patching the affected eye and initiation of antiplatelet therapy

**Answer: C.** Diabetic cranial mononeuropathy may affect the third, fourth, or sixth cranial nerve (CN). It is a diagnosis of exclusion, and brainstem ischemic or hemorrhagic lesions should also be considered. The long intracranial course of the sixth nerve makes MRI scanning particularly indicated to rule out a mass lesion. Once it is diagnosed, patching, analgesics, and antiplatelet therapy should be considered for management of this diabetic complication.

**95.7.** A 38-year-old woman presents 8 weeks postpartum with a 1-week history of severe headache and progressively altered mental status, which culminated in a seizure several minutes before presentation. On examination, she is normotensive, appears postictal, but has no focal neurologic findings. Ophthalmoscopic examination reveals papilledema, and non-contrast-enhanced head computed tomography (CT) reveals a dense sagittal sinus and a small venous hemorrhage in the occipital region. The next most appropriate management step is:

- A. 325 mg aspirin per rectum
- B. Dexamethasone 10 mg IV push
- C. Hypertonic saline 500-mL bolus
- D. Mannitol 1 g/kg
- E. Systemic anticoagulation with unfractionated heparin or low-molecular-weight heparin (LMWH)

**Answer: E.** The patient presents with a dural sinus thrombosis. Although large, randomized trial data do not exist, case series and expert consensus strongly suggest improved outcomes with systemic anticoagulation, even in the setting of venous hemorrhage on head CT. Osmotic agents and steroids have no proven benefit in the management of sinus thrombosis and may cause harm. Antiplatelet agents may be considered if absolute contraindications to anticoagulation exist but probably have lower therapeutic efficacy.

**95.8.** A 20-year-old female college student presents with her third episode of bilateral foot numbness after a game of volleyball. Each episode has occurred approximately 1 or 2 hours after a full game of indoor volleyball, which she had no trouble completing. Each of the episodes of foot numbness resolved during 2 or 3 days with no residual symptoms. Her only other complaint is of falling grades in school due to subjective poor memory and distractibility. What would be the most likely finding in this patient?

- A. Elevated cerebrospinal fluid (CSF) protein levels
- B. Elevated erythrocyte sedimentation rate
- C. Hypocalcemia
- D. Increased intracranial pressure (ICP) on lumbar puncture
- E. Thrombocytopenia

**Answer: A.** Presenting symptoms for multiple sclerosis (MS) may be myriad. Uhthoff's phenomenon is the finding in MS in which small increases in body temperature exacerbate neurologic symptoms temporarily. Almost any neurologic complaint or finding may be a feature of MS, with up to 60% having cognitive impairment. CSF analysis is abnormal in 90% of cases with a pleocytosis and elevated protein with oligoclonal bands. ICP is normal. Lumbar puncture is undertaken after magnetic resonance imaging (MRI), which is the initial imaging test of choice.



## KEY CONCEPTS

- When faced with neurologic dysfunction, the clinician needs to narrow probable location down to brain, cord, or motor end-plate by history and physical examination.
- Complete cord syndromes are characterized by total loss of voluntary motor, sensory, and autonomic innervation distal to the level of cord injury. Partial cord injuries are characterized by sparing of some of these modalities.
- The bulbocavernosus reflex is cord-mediated. Return of this reflex following a spinal injury marks the termination of spinal shock.
- Central cord syndrome is frequently the result of hyperextension injuries in the setting of a narrowed cervical canal producing a syndrome of upper extremity > lower extremity effect marked by weakness > sensory deficits.
- Anterior cord syndrome is marked by symmetrical motor loss but intact proprioception and vibration sense.
- In patients with sudden severe back pain, consider spinal subarachnoid hemorrhage or spinal epidural abscess (SEA).
- Myelitis is an inflammation of the spinal cord often caused by a viral infection; steroids have no proven benefit. MRI with contrast enhancement is the diagnostic modality of choice.
- Cauda equina syndrome can be difficult to differentiate from conus lesions because both can result in overflow bladder/fecal incontinence, leg weakness, and sensory loss in the perineum. Conus lesions are more typically bilateral, whereas cauda equina syndrome is unilateral. Upper motor neuron findings are expected with conus lesions but not cauda equina syndrome.
- The diagnostic imaging of choice in the majority of suspected spinal disorders is a MRI with contrast.
- A syrinx is a cavitary lesion in the spinal cord that presents with a sensory disassociation predominately in the upper extremities. With progression, it can lead to upper extremity weakness/wasting. Exacerbation with cough or Valsalva is typical.
- With compressive lesions of the spinal cord, duration of neurologic dysfunction is directly related to ultimate neurologic outcome. The diagnosis should be made expeditiously and definitive therapy begun as soon as possible.

## CHAPTER 96: QUESTIONS &amp; ANSWERS

- 96.1.** Which of the following physical findings indicates a partial rather than a complete cervical spinal cord lesion?
- Horner's syndrome
  - Hypotension
  - Intact perineal sensation
  - Priapism
  - Reflex tachycardia

**Answer: C.** Persistent perineal sensation, rectal sphincter tone, or even trace toe movement suggests a partial spinal cord lesion. This offers a far better prognosis than a complete transection.

- 96.2.** Which of the following physical findings is a marker for spinal shock?
- Babinski's response present
  - Bulbocavernosus reflex absent
  - Lower extremity hyperreflexia present
  - Perineal sensation present
  - Priapism present

**Answer: B.** The bulbocavernosus reflex is a cord-mediated reflex signified by reflex contraction of the anal sphincter in response to squeezing of the glans penis or tugging on the Foley catheter. The termination of spinal shock is heralded by return of this reflex followed by increased muscle tone and hyperreflexia.

- 96.3.** A 49-year-old man presents after a moderate-speed motor vehicle collision. He was an unrestrained driver who was rear-ended at a stop light. He suffered no head impact but reported a whiplash mechanism and complains of neck pain and a mild burning sensation in both palms. Vital signs and physical examination are unremarkable except for posterior cervical paraspinal muscle tenderness and modest allodynia of both palms and fingertips in a nondermatomal distribution. What is the expected finding on magnetic resonance imaging (MRI)?
- Anterior spinal cord ischemia
  - C5–6 traumatic spondylolisthesis
  - Cervical canal stenosis
  - Normal MRI
  - Unilateral C5–6 disk protrusion

**Answer: C.** Central cord syndrome is a typically post-traumatic event in either elderly individuals with degenerative cervical canal narrowing (osteophytes, ligamentum flavum hypertrophy, facet overgrowth) or younger individuals with congenitally narrowed canals. A hyperextension mechanism in the setting of a narrow canal produces a central cord impingement with an upper > lower extremity motor > sensory deficit pattern. Bladder dysfunction is variable. Early MRI may show no actual cord changes and only the canal narrowing. Upper extremity dysesthesia may be the only symptom.

- 96.4.** A 73-year-old man is brought to the ED by family members for weakness. His only past history is peripheral vascular disease. He is found to be in septic shock and resuscitated with fluid, antibiotics, blood, and vasopressors. He ultimately requires both dopamine and norepinephrine for maintenance of a mean arterial pressure greater than 60 mm Hg. Approximately 5 hours after arrival, he develops bilateral lower extremity weakness. He has no prior history of back pain or neurologic problems. Which of the following is likely?
- A similar neurologic syndrome after a cervical hyperflexion injury
  - Finding of a mass lesion on MRI
  - Finding of an epidural hematoma
  - Preservation of lower extremity temperature sensation
  - Progressive return of function after 24 hours

**Answer: A.** Anterior cord syndrome is typically characterized by symmetrical loss of motor function and pain and temperature sensation (both tracts being located in the anterior portion of the cord). Proprioception and vibration sense are usually maintained. Although it may occur after a cervical flexion injury, it is most likely seen after periods of hypotension or instability, such as shock, infection, and myocardial infarction. Most improvement occurs in the first 24 hours.

- 96.5.** What feature most likely distinguishes a conus medullaris from a cauda equina lesion?
- Back pain
  - Bilateral symptoms
  - Distal motor weakness
  - Sacral anesthesia
  - Urinary incontinence



**Answer: B.** Isolated conus lesions are rare, but because of the small size, they frequently result in bilateral symptoms. Cauda equina syndrome more frequently results in unilateral findings. An additional distinguishing feature may be the presence of upper motor neuron findings in conus medullaris syndrome. Both syndromes may cause overflow bladder incontinence, fecal incontinence, leg weakness, and sensory loss in the perineum.

**96.6.** A 27-year-old woman presents with complaints of back pain and difficulty walking. Her symptoms have been progressive for 2 days. She has no significant past medical history. Her only other symptom was a bout of influenza approximately 3 weeks prior. Physical examination is remarkable for lower extremity hyperreflexia, moderate symmetrical lower extremity weakness, moderate increased tone, a T10 level of sensory loss, and a postvoid residual urine volume of 350 mL. What should be the next intervention?

- A. Antibiotics
- B. Complete blood count, erythrocyte sedimentation rate (ESR), and antinuclear antibody levels
- C. MRI scan
- D. Neurology consultation
- E. Steroids

**Answer: C.** Transverse myelitis is postinfectious in 30% of cases and also idiopathic in 30%. Other causes are autoimmune disorders and infections. Symptoms are typically rapid in onset and progress during 1 or 2 days. Back pain may accompany it. Emergent MRI is indicated to rule out other causes. There is no proven efficacious treatment, although steroids have been used. There is an association with multiple sclerosis (MS). Prognosis for recovery is only fair.

**96.7.** Which of the following characteristics is a feature of syringomyelia?

- A. Absence of neck pain
- B. Exacerbation with cough or Valsalva maneuver
- C. Loss of vibrating sensation in the arms
- D. Normal cervical MRI
- E. Normal lower extremity examination

**Answer: B.** Syringomyelia typically presents with headache, neck pain, and variable upper extremity dissociative anesthesia: symmetrical loss of pain and temperature sensation with preserved posterior column function. With progression, upper extremity weakness or wasting and lower extremity upper motor neuron changes are expected. Exacerbation with cough and the Valsalva maneuver is typical. There is a 90% association with type I Arnold-Chiari malformation (cerebellar tonsils and medulla projecting into the spinal canal—often the cause of the typical occipital headaches). MRI is diagnostic.

## KEY CONCEPTS

- It is not usually possible to arrive at the diagnosis of a specific peripheral neuropathy in the ED because of the need for confirmatory ancillary testing. One should focus on identifying one of seven categorical patterns of peripheral neuropathy, shown in [Figure 97.1](#) and listed in [Table 97.1](#).
- One of these seven patterns can usually be identified by combining three clinical features that are readily obtainable from a goal-directed history and physical: (1) right-left symmetry or asymmetry, (2) proximal-distal location, and (3) sensorimotor modalities affected.
- Identification of the type of peripheral neuropathy determines the need for ancillary diagnostic testing, therapeutic intervention, disposition, and timing of neurologic referral.
- Any patient with symmetrical weakness, distributed both proximally and distally, with loss or diminution of DTRs and variable sensory abnormalities should be treated as having GBS.
- Respiratory compromise is the primary life-threatening event seen in some peripheral neuropathies; GBS is by far the most common peripheral neuropathic cause of respiratory arrest.
- The definitive treatments for GBS are plasma exchange or intravenous immune globulin (IVIG).
- Most polyneuropathies are characterized by a pattern of distal, symmetrical sensorimotor findings, worse in the lower than in the upper extremities, with a stocking-glove distribution of sensory abnormalities that gradually diminishes as one moves proximally.
- High level evidence supports the use of tricyclic antidepressants, anticonvulsants, and the serotonin and norepinephrine reuptake inhibitor nuloxetine treating diabetic DSPN.
- Radial nerve mononeuropathies are characterized by wrist and finger drop and mild numbness over the skin of the first dorsal interosseus muscle.
- Humeral shaft fractures are associated with radial nerve injury, with “wrist drop” the hallmark clinical finding.
- The ulnar cutaneous innervation to the hand branches from the main trunk proximal to the nerve entering Guyon’s canal thus a lesion at the wrist should not produce sensory abnormalities, whereas one at the elbow would be expected to do so.
- The most specific finding for carpal tunnel syndrome (CTS) is splitting of the fourth digit (ie, normal sensation of the ring finger on the ulnar palmar side with abnormal sensation on the median [radial] palmar side of the same finger).
- Lateral femoral cutaneous mononeuropathy (meralgia paresthetica) is caused by injury to this pure sensory nerve as it passes through or over the inguinal ligament, where it may become entrapped or kinked.
- The most striking feature of a complete common peroneal mononeuropathy is footdrop caused by weakness of foot dorsiflexion.
- The most common neurologic abnormality in Lyme disease is unilateral or bilateral facial nerve palsy, usually occurring within a month of exposure.
- ALS requires the presence of both upper and lower motor neuron findings, and is the most common form of motor neuron disease (MND).

## CHAPTER 97: QUESTIONS &amp; ANSWERS

**97.1.** Which category of peripheral neuropathy tends to occur in an asymmetrical, distal distribution?

- Autonomic neuropathy
- Large-fiber neuropathy
- Mixed motor and sensory neuropathy
- Neuropathy from vasculitis
- Pure motor neuropathy

**Answer: E.** Pure motor and pure sensory peripheral neuropathies tend to occur in an asymmetrical distal pattern.

**97.2.** A 26-year-old woman presents with a chief complaint of weakness. She notes a 1- or 2-day onset of easy fatigability and diminished ability to navigate stairs. She has no past history and takes no medications. Vital signs are normal. Physical examination reveals absent lower extremity deep tendon reflexes (DTRs); symmetrical weakness of the quadriceps, calf muscles, and foot/toe dorsiflexion; and minimal sensory loss. Cranial nerve and upper extremity examination is normal. Which of the following is likely?

- An antecedent viral illness
- Lack of anal sphincter tone
- Onset of ocular muscle dysfunction
- Sparing of the autonomic nervous system
- Urinary retention

**Answer: A.** Guillain-Barré syndrome (GBS) is characterized by fairly acute onset of ascending weakness, loss of deep tendon reflexes (DTRs), and variable sensory loss. Antecedent infections often trigger, with common organisms being campylobacter, cytomegalovirus, Epstein-Barr virus, and mycoplasma. Rarely, symptoms begin in the upper extremities. Urinary retention is common, but anal tone is preserved. Ocular muscles are usually spared. Autonomic neuropathy is common, with marked variations in heart rate and blood pressure. Patients with predominantly sensory symptoms tend to have less risk of respiratory embarrassment and a more favorable prognosis. Lumbar puncture shows cerebrospinal fluid (CSF) pleocytosis or may be normal early on.

**97.3.** A 26-year-old woman presents with lower extremity weakness and difficulty walking. Examination is remarkable for lower extremity symmetrical weakness with mild symmetrical sensory loss and absent lower

extremity deep tendon reflexes (DTRs). Symptom onset has been during 2 days. What should be the next step?

- Emergent magnetic resonance imaging (MRI)
- Intravenous immune globulin (IVIG)
- Lumbar puncture and antibiotics
- Pulmonary function studies
- Urgent neurologic consultation

**Answer: D.** All patients with Guillain-Barré syndrome (GBS) are at risk of respiratory failure. A forced vital capacity (FVC) of less than 20 mL/kg and a negative inspiratory force of less than 30 cm H<sub>2</sub>O are associated with impending ventilatory failure and the need for intubation.

**97.4.** Among patients with Guillain-Barré syndrome (GBS) who have normal pulmonary function, which of the following can be monitored to predict impending ventilatory failure?

- Deltoid strength
- Extensor neck strength
- Hand grip strength
- Masseter strength
- Rectus abdominis strength

**Answer: B.** Extensor muscle strength has been shown to correlate with ventilatory muscle strength.

**97.5.** A 53-year-old diabetic presents with a complaint of increasing difficulty walking in the last several months. He has no other past history but has been an insulin-dependent diabetic for 23 years. Current glucose level is 138 mg/dL, and chemistries and complete blood count are otherwise unremarkable. Examination is remarkable for bilateral lower extremity numbness extending symmetrically to above the knees, loss of the Achilles reflex bilaterally with footdrop, and steppage gait. Which of the following is true?

- Autonomic neuropathy is unlikely.
- Facial numbness would necessitate MRI.
- Hand numbness is expected.
- Erythrocyte sedimentation rate is likely to be elevated.
- Lumbar spine MRI will likely show a pathologic process.

**Answer: C.** Diabetic neuropathy is a progressive, ascending mixed polyneuropathy. Hand numbness and upper extremity symptoms usually begin before the lower extremity symptoms ascend to the knees. Extensive motor loss can occur with gait and grip abnormalities. Skull and face numbness can occur. Autonomic dysfunction is expected.

**97.6.** A 53-year-old diabetic presents with increasing symmetrical dysesthetic pain from his well-documented severe diabetic neuropathy. His only medications are insulin and over-the-counter analgesics. Laboratory evaluation is remarkable for a glucose concentration of 183 mg/dL and a creatinine level of 2.1 mg/dL with normal chemistries. Which of the following is indicated as a first-line analgesic in this patient?

- A. Amitriptyline
- B. Hydrocodone with acetaminophen
- C. Naprosyn sodium
- D. Paroxetine
- E. Tramadol

**Answer: A.** First-line agents for neuropathic pain are the anticonvulsants and cyclic antidepressants. Specifically, gabapentin, pregabalin, amitriptyline, imipramine, and nortriptyline are useful. Tramadol and opiates may be effective but less so. Tramadol is renally excreted (as is gabapentin), and doses must be adjusted for falling creatinine clearances. Nonsteroidal antiinflammatory drugs (NSAIDs) do not have great usefulness for neuropathic pain (there is no “inflammatory” component) and would be contraindicated with elevated creatinine. Opiates may be beneficial, but issues of tolerance are significant. Selective serotonin reuptake inhibitors may be effective but are second-line agents (the norepinephrine-modulating ability of tricyclic antidepressants makes them more effective analgesics than the serotonin-specific agents).

**97.7.** Which of the following characteristics separates the clinical picture of alcoholic versus diabetic neuropathy?

- A. Autonomic changes
- B. Incontinence
- C. Myopathy
- D. Sensory loss
- E. Weakness

**Answer: C.** The presence of myopathy and cerebellar degeneration helps distinguish alcoholic neuropathy. Otherwise, the clinical pictures are similar. Incontinence is not a typical feature of either.

**97.8.** What is the most common neurologic complication of HIV infection?

- A. Autonomic neuropathy
- B. Cerebellar dysfunction
- C. Cranial nerve dysfunction
- D. Peripheral neuropathy
- E. Spinal anterior horn degeneration

**Answer: D.** It is typically a distal mixed motor and sensory polyneuropathy. It is triggered by a combination of poorly defined immune mechanisms and dideoxynucleoside therapy.

**97.9.** A 53-year-old woman presents with progressive pain involving her left shoulder and upper arm. She describes a deep aching pain that is poorly localized and is occasionally accompanied by tingling sensations in the left hand in a nondermatomal pattern. Her medical history is negative except for a history of left-sided breast cancer 6 years prior for which she underwent a total mastectomy followed by field irradiation and oral antiestrogen therapy. She currently takes no medications. Review of systems and laboratory results are negative. Physical examination shows only left shoulder dysesthesias. The chest radiograph is normal. What should be the next step?

- A. Computed tomography scan of the chest
- B. Gabapentin in titrated doses
- C. Hydrocodone with acetaminophen and reassurance
- D. MRI scan of the brachial plexus
- E. Referral for upper extremity electromyography (EMG) and nerve conduction studies (NCSs)

**Answer: D.** Although plexopathies are most commonly post-traumatic, radiation, postviral, and infiltrative processes also occur. In a patient who is status post an oncologic diagnosis and radiation therapy, oncologic recurrence must be ruled out with an imaging study. Radiation plexopathy, which can occur up to 20 years out, is most often a diagnosis of exclusion and ultimately requires symptomatic treatment of neuropathic pain.

## KEY CONCEPTS

- The approach to evaluation of patients with acute neuromuscular weakness is facilitated by first determining the location of the lesion (spinal cord, nerve, neuromuscular junction, or muscle) and then considering the most common disorders that affect the area in question.
- In patients presenting with acute neuromuscular weakness, complaints of difficulty in breathing or swallowing should heighten suspicion of bulbar involvement with possible airway compromise. In such patients, FVC of less than 15 mL/kg or maximal NIF of less than 15 mm H<sub>2</sub>O is a potential indication for mechanical ventilation.
- Patients with a neuromuscular decline in respiratory function can be given a trial of noninvasive ventilation.
- The edrophonium and ice bag tests can be useful bedside tests in the evaluation of a suspected new diagnosis of myasthenia gravis.
- Plasma exchange therapy and IVIG are both useful for the treatment of myasthenic crises with the choice dependent on which is available and preferred in the ICU.
- Botulism usually arises as a painless descending paralysis, often first affecting the cranial nerves and bulbar muscles, without sensory deficits or significant alteration of consciousness. The treatment is airway management and administration of antitoxin.
- Injection drug use remains an important cause of wound botulism outbreaks.
- Botulism must be considered in the evaluation of a weak and floppy infant.
- In hypokalemic periodic paralysis, the total body potassium level is not depleted, only shifted intracellularly; treatment should keep this in mind as potassium is administered with frequent checks of serum potassium levels.
- In newly diagnosed hypokalemic periodic paralysis, the patient should be evaluated and treated for hyperthyroidism if present.

## CHAPTER 98: QUESTIONS &amp; ANSWERS

**98.1.** Which of the following is an indication for intubation in a 70-kg patient with weakness due to neuromuscular disease?

- A. Arterial Pco<sub>2</sub> of 42 mm Hg
- B. Forced vital capacity (FVC) of 950 mL
- C. Negative inspiratory force (NIF) of 18 mm Hg
- D. Oxygen saturation of 95% on room air
- E. Respiratory rate of 24 breaths per minute

**Answer: B.** An FVC less than 15 mL/kg or an NIF less than 15 mm Hg are indications for intubations. Regarding arterial blood gas analysis, functional reserve can be severely diminished by the time a patient develops hypoxia or hypercarbia.

**98.2.** Match the following pathologic conditions with their correct associated finding(s):

- A. Motor neuron disease—upper/lower motor neuron findings
- B. Myelopathy—preserved sensation
- C. Myopathy—distal weakness that ascends
- D. Neuromuscular junction disease—Babinski's response
- E. Neuropathy—acute cranial nerve deficit

**Answer: A.** Amyotrophic lateral sclerosis (ALS) and polio are the classic cases of motor neuron disease. The typical presentation is a mix of upper and lower motor neuron findings. The following are other correct associations:

- Myopathy—preserved sensation
- Neuromuscular junction disease—acute cranial nerve deficit
- Myelopathy—Babinski's response
- Neuropathy—distal weakness that ascends

**98.3.** You have intubated a patient in myasthenic crisis but do not have plasmapheresis immediately available in your hospital. Your next choice of therapy would be:

- A. Begin intravenous (IV) pyridostigmine
- B. Begin IV immune globulin 1 g/kg daily
- C. Edrophonium 1 mg IV test dose followed by 3–5 mg IV
- D. Start rituximab

**Answer: B.** Although evidence supporting IV immune globulin is weak, it is an accepted alternative to plasmapheresis. Pyridostigmine and neostigmine are used orally for maintenance and not for acute crisis, and the IV dose might cause complications from the cholinergic excess, such as increased secretions.

**98.4.** A 24-year-old Mexican male presents with hypokalemic periodic paralysis. His potassium level is 1.6 mEq/L. After receiving 2 L of normal saline IV and KCl 30 mEq IV over 3 hours, his vital signs are blood pressure 178/96, heart rate 126, temperature 38°C, and respiratory rate 16. His weakness is not improving. What is the most appropriate next therapeutic option?

- A. KCl 20 mEq IV bolus
- B. Plasmapheresis
- C. Prophylactic intubation for airway protection
- D. Propranolol 40 mg by mouth

**Answer: D.** For patients with thyrotoxic periodic paralysis, the weakness often does not correct if the hyperthyroid state is not treated along with the hypokalemia. Thyrotoxic periodic paralysis is more common in Japanese and Hispanic men. Such patients also do not usually manifest paralysis unless their potassium level drops while they are hyperthyroid.

## KEY CONCEPTS

- CNS infection should be considered in all patients with headache, neck stiffness, fever, altered sensorium, or diffuse or focal neurological findings.
- *S. pneumoniae* is one of the two leading causes of bacterial meningitis in adults. Mortality from *S. pneumoniae* is 30%.
- Perform (and document) a funduscopic examination and focused neurologic examination to include mental status (pay close attention to cranial nerves 2, 3, 4, and 6).
- Altered mental status in a patient with suspected meningitis can be a sign of increased ICP or encephalitis.
- Sampling of CSF is the only reliable method of assessing the presence or absence of meningitis. In the absence of contraindications, any suspicion of meningitis is an indication to perform a CSF analysis.
- Provide critical monitoring and be aware of the risk for rapid deterioration.
- Early initiation of empirical antimicrobial therapy is recommended in cases of suspected acute CNS infection. Antibiotic administration should not be delayed for CSF analysis or performance of neuroimaging studies.
- Antibiotic chemoprophylaxis should be assured for close contacts of patients with meningitis resulting from *N. meningitidis* or *H. influenza*. Single-dose and multiple-dose regimens are available.
- Concomitant CNS infection should be strongly considered in any symptomatic patient with another severe systemic infection, such as urinary tract infection or pneumonia.
- First line treatment for bacterial meningitis is ceftriaxone plus vancomycin.
- Acyclovir is recommended for patients with suspected meningoencephalitis.
- Dexamethasone is recommended prior to treatment with antibiotics in adults.
- Discuss with patients and families the critical nature of the disease and the potential for morbidity and mortality.

## CHAPTER 99: QUESTIONS &amp; ANSWERS

99.1. Which of the following is typically the first step in the pathogenesis of bacterial meningitis?

- A. Cutaneous colonization
- B. Direct invasion via a meningeal disruption
- C. Hematogenous seeding
- D. Middle ear colonization
- E. Nasopharyngeal colonization

**Answer: E.** Virulent microbes secrete proteases and induce cellular ciliostasis. They are then able to evade the complement pathway and cross the blood-brain barrier.

99.2. Which of the following is typically the first step in the pathogenesis of viral meningitis?

- A. Cutaneous colonization
- B. Direct invasion via a meningeal disruption
- C. Hematogenous seeding
- D. Middle ear colonization
- E. Nasopharyngeal colonization

**Answer: C.** Viruses may enter the host through almost any portal, replicate outside of the central nervous system (CNS), and gain access via hematogenous spread.

99.3. In the pediatric population, where is the most common location of intraparenchymal brain abscesses that are otogenic in origin?

- A. Cerebellar
- B. Frontal
- C. Occipital
- D. Parietal l
- E. Temporal

**Answer: A.**

99.4. A 44-year-old woman presents with fever and headache of 2 days' duration. Vital signs are remarkable for fever, tachycardia, and hypotension with a blood pressure of 80/40 mm Hg. Chest radiograph and noncontrast computed tomography (CT) scan of the brain are unremarkable. Antibiotics are given. Laboratory evaluation is remarkable for leukocytosis with hemoglobin 12 g/dL, sodium 128 mEq/L, potassium 5.5 mEq/L, blood urea nitrogen (BUN) 25 mg/dL, creatinine 0.9 mg/dL, and bicarbonate 26 mEq/L. Lumbar puncture (LP) confirms

meningitis with gram-negative cocci, pleocytosis, elevated protein, and low glucose. Opening pressure is 20 cm H<sub>2</sub>O. Hypotension persists despite several liters of normal saline and titration of dopamine at 15 µg/kg/min. What should be the most appropriate next step?

- A. Hydrocortisone intravenously
- B. Mannitol 0.5 g/kg
- C. Norepinephrine
- D. Phenylephrine infusion
- E. Transfusion of packed red cells

**Answer: A.** Overall, the complications from meningococcal meningitis are less than with pneumococcal disease. The incidence of Waterhouse-Friderichsen syndrome is dramatically higher. The presence of refractory hypotension, hyponatremia, and hyperkalemia strongly suggests adrenal insufficiency.

99.5. A 46-year-old man is brought to the emergency department (ED) for acute mental status changes and fever that have evolved rapidly over 24 hours. The emergency medical service (EMS) transport team reports a noticeable decline during transport. Immediately upon arrival, the patient experiences a brief grand mal seizure. Vital signs are temperature, 39.3° C; heart rate, 133 bpm; blood pressure, 110/60 mm Hg; respiratory rate, 20 breaths per minute; and oxygen saturation, 95%. Fluid resuscitation is begun. Noncontrast computed tomography (CT) scan of the head is negative. Physical examination is remarkable for modest meningismus. Which of the following statements is true?

- A. The next step should be blood cultures and antibiotics.
- B. The next step should be contrasted CT scan.
- C. The next step should be dexamethasone 10 mg intravenously.
- D. There are no predictable risk factors for herniation.
- E. Raised intracranial pressure (ICP) is reliably detected by CT scan.

**Answer: A.** The controversy regarding not performing a lumbar puncture (LP) despite a normal CT is based on emergency reports of a fulminant herniation syndrome temporarily related to LP preceded by a normal CT. These reports reinforce the fact that CT cannot exclude raised ICP. Risk factors for the herniation syndrome are clinical signs of raised ICP, acute mental status deterioration, and recent seizures. In these cases, blood cultures and empirical antibiotics are indicated in lieu of a confirmatory LP.



**99.6.** Cerebrospinal fluid (CSF) turbidity is usually seen with CSF leukocytosis above which of the following?

- A. 100 cells/mm<sup>3</sup>
- B. 200 cells/mm<sup>3</sup>
- C. 300 cells/mm<sup>3</sup>
- D. 400 cells/mm<sup>3</sup>
- E. 500 cells/mm<sup>3</sup>

**Answer: B.** Leukocytosis is the most common cause of CSF turbidity.

**99.7.** Which of the following findings should be considered the cutoff for indicating a normal cerebrospinal fluid (CSF) result?

- A. Total cell count >4; polymorphonuclear (PMN) count = 0
- B. Total cell count >5; PMN count = 1
- C. Total cell count >6; PMN count = 2
- D. Total cell count >8; PMN count = 3
- E. Total cell count >10; PMN count = 4

**Answer: B.** Normal CSF contains at most five leukocytes with at most one PMN leukocyte.

**99.8.** A 27-year-old woman presents with fever, headache, and mild neck pain. Physical examination is unremarkable except for neck pain with mild meningismus and a fever of 39.5° C. Blood tests, chest radiograph, and urinalysis are negative. Lumbar puncture (LP) results are lymphocytes 3 cells/mm<sup>3</sup> and polymorphonuclear (PMN) leukocyte is 0. Glucose and protein levels are normal. No organisms are seen on gram stain. What should be the next step?

- A. Computed tomography (CT) scan with intravenous (IV) contrast
- B. IV antibiotics and admission
- C. IV ceftriaxone and a 24-hour recheck
- D. Magnetic resonance imaging (MRI) scan
- E. Reassurance and analgesics

**Answer: B.** Normal cell counts and differential diagnoses, in the face of a compatible clinical picture, do not rule out meningitis. Such patients require antibiotics, admission, reevaluation, and sometimes repeat lumbar puncture (LP). Brain abscesses and parameningeal infections may likewise present with normal cerebrospinal fluid (CSF).

**99.9.** Cerebrospinal fluid (CSF) xanthochromia may persist for up to how long?

- A. 24 hours
- B. 2 days
- C. 7 days
- D. 14 days
- E. 1 month

**Answer: E.** CSF xanthochromia may persist for up to 1 month. Also, if a traumatic tap introduces enough protein to raise the CSF level to 150 mg/dL, blood pigments may cause xanthochromia.

## KEY CONCEPTS

- Thought disorder symptoms can be precipitated by psychiatric, underlying medical, and toxicologic etiologies.
- Diagnostic testing should be patient specific and based on the particular medical processes that the clinician feels may be causing or exacerbating the thought disorder, rather than panels of routine tests.
- Consider nonphysical intervention first when appropriate, but chemical sedation and physical restraint are immediately necessary for patients who demonstrate aggressive and dangerous behavior.
- Appropriate disposition depends on the etiology of the underlying psychosis, response to treatment, and patient and community safety considerations and, more often than not, includes psychiatric consultation.

## CHAPTER 100: QUESTIONS &amp; ANSWERS

**100.1.** Which of the following pharmacologic agents have been implicated in causing acute psychosis?

- A. Aripiprazole, hydralazine, nitroglycerin
- B. Diazepam, rifampin, captopril
- C. Hydrochlorothiazide, acetaminophen, albuterol
- D. Lorazepam, salsalate, rocuronium
- E. Penicillin, ceftriaxone, risperidone

**Answer: B.** Box 100.2 provides an extensive list of other agents that may cause psychosis.

**100.2.** Rapid tranquilization using a neuroleptic agent would be indicated in which of the following cases?

- A. An intoxicated schizophrenic
- B. Anticholinergic psychosis
- C. A lactating schizophrenic
- D. A phencyclidine overdose
- E. A pregnant schizophrenic

**Answer: A.** Neuroleptics are contraindicated in choices B to E. They should not be the sole agent for alcohol withdrawal but would be useful for acute psychotic agitation.

**100.3.** A 45-year-old woman presents to the emergency department (ED) for a complaint of severe anxiety and unrest. Her past history is significant only for moderate schizophrenia, for which she was placed on olanzapine 2 months prior. She has been compliant. Physical examination is remarkable for the presence of anxiety, clear sensorium and orientation, and normal speech. She is restlessly pacing the room and reports being compelled to keep moving. Urine drug screen is negative. What would be the most appropriate therapy?

- A. Benztropine orally
- B. Lorazepam orally
- C. Olanzapine intravenously
- D. Psychiatry consultation
- E. Ziprasidone intravenously

**Answer: A.** Akathisia is a state of motor restlessness characterized by a physical need to be constantly moving. The patient does not want to do so but feels compelled. It is most commonly seen in middle-aged patients within the first few months of starting treatment. It may be mistaken for an acute deterioration, but psychotic features are not increased. Treatment is with oral beta-blockers and anticholinergics (benztropine).

**100.4.** What is the most common adverse effect seen with neuroleptic agents?

- A. Akinesia
- B. Dystonia
- C. Orthostatic hypotension
- D. Pseudoparkinsonism
- E. Tardive dyskinesia

**Answer: B.** Dystonia occurs in 1% to 5% of this patient population. The reaction occurs because of a dopaminergic pathway disruption with a resulting cholinergic predominance. Anticholinergics should be administered parenterally (Benadryl 25 to 50 mg intravenous [IV] or Cogentin 1 or 2 mg IV), followed by 48 to 72 hours of oral follow-up treatment to prevent recurrence. Patients may experience tongue protrusion (buccolingual crisis), upward eye deviation (oculogyric crisis), back arching (opisthotonus), and, rarely, laryngospasm. Symptoms may lessen with voluntary muscle action and increase with stress.

**100.5.** A 27-year-old known schizophrenic is brought to the emergency department (ED) for altered mental status. His only known medication is clozapine, which he started 4 weeks ago with subsequent dose increases. He has no other past history. Physical examination is remarkable for a muscular black man who is somnolent and diaphoretic. He withdraws all extremities stiffly and grimaces to pain. Vital signs are temperature, 40.5° C; heart rate, 146 beats per minute; blood pressure, 205/125 mm Hg; and respiratory rate 28 breaths per minute. Rectal examination is guaiac positive. Foley placement shows brown urine. What should be the next diagnostic maneuver?

- A. Creatine kinase level
- B. Head computed tomography (CT) scan
- C. Lumbar puncture
- D. Thyroid hormone levels
- E. Urine drug screen

**Answer: A.** Neuroleptic malignant syndrome is an idiopathic condition clinically similar to serotonin syndrome and malignant hyperthermia. Milder cases may be confused with serotonin syndrome. Severe cases, related to possible hypothalamic dysfunction, present with fever, rigidity, altered mental status, autonomic instability, and elevated creatine phosphokinase (CPK) and possibly rhabdomyolysis. It is seen with both typical and atypical antipsychotics and generally occurs in the first few weeks of treatment. Complications may include hepatic/renal failure, gastrointestinal (GI) hemorrhage, and respiratory failure. Severe cases may require intravenous dantrolene or dopamine agonists (eg, bromocriptine).

## KEY CONCEPTS

- Patients with apparent mood disorders should be evaluated for medical disorders, medication effects, or substance abuse or withdrawal because these conditions can mimic both depression and mania.
- Mood disorders should be suspected in patients with multiple, vague, nonspecific complaints and in patients who are frequent, heavy users of medical care.
- The differentiation of depression and dementia in elders can be difficult but is important because depression often responds dramatically to treatment.
- Patients with mood disorders should be assessed for their suicide potential.

## CHAPTER 101: QUESTIONS &amp; ANSWERS

101.1. What is the lifetime suicide risk for people with major untreated depression?

- A. 5%
- B. 10%
- C. 15%
- D. 20%
- E. 25%

**Answer: C.** Patients with major depression have a high lifetime suicide risk, and although episodes of acute decompensation with even higher risk can be identified and treated, a certain number of patients succeed in committing suicide.

101.2. Which of the following imbalances of central nervous system neurotransmitters is seen in patients with clinical depression?

- A. Decreased hypothalamic-pituitary-adrenal (HPA) activity
- B. Depressed serotonin levels
- C. Elevated gamma-aminobutyric acid (GABA) levels
- D. Elevated norepinephrine levels
- E. Unchanged dopamine levels

**Answer: B.** The central biochemical features toward which pharmacologic management is directed are depressed levels of norepinephrine and serotonin. Data are also emerging that suggest decreased dopamine levels. The HPA axis may also be altered with elevated cortisol levels.

101.3. Which of the following statements regarding depression in children and elders is *true*?

- A. Children with depression rarely present with somatic complaints.
- B. Depression in children may be manifested as attention deficit disorder (ADD).
- C. Depression presents differently from dementia in elders.
- D. Diagnostic criteria for depression in children are different.
- E. Serious depression in elders is generally refractory to treatment.

**Answer: B.** Depression in children and adolescents can be manifested as ADD. Somatic complaints are a common feature of children and adolescents presenting with depression, but the diagnostic criteria are not different. Geriatric depression may be manifested in a manner similar to dementia (pseudodementia), but unlike dementia, the depression is highly treatable and reversible once it is recognized.

101.4. A 31-year-old attorney is brought to the emergency department (ED) by his family for a chief complaint of agitation and a behavioral change. He has no past medical history and takes no medications. The family reports decreased sleep, increased talkativeness, marked increased time and involvement at work, and an uncharacteristic buying spree. Your examination is remarkable for distractibility, gregarious and pressured speech, flight of ideas, and mild psychomotor agitation. Laboratory examination and urine drug screen results are negative. The patient is adamant that he has important things to do and needs to leave. Which of the following statements is most true?

- A. Antipsychotic agents are not effective.
- B. Hallucinations would be atypical.
- C. If treated, intravenous valproic acid is indicated.
- D. Initiating treatment in the ED is not indicated.
- E. Multiple antibiotics can cause this clinical picture.

**Answer: E.** This patient has a fairly classic presentation for acute mania with pressured speech, distractibility, grandiosity, increased involvement (in this case with work), and decreased need for sleep. Multiple drugs may precipitate this, including acyclovir, isoniazid, sulfonamides, the floxins, and chloroquine. An acute manic episode may be manifested with hallucinations and mimic an acute psychosis. ED treatment is usually indicated for this disorder. Acute stabilization is generally effective with major tranquilizers, such as haloperidol.

## KEY CONCEPTS

- Patients who present with predominant symptoms of anxiety may be suffering from medical disorders, medication effects, or substance abuse or withdrawal.
- Anxiety may accompany the onset of serious medical disease, cause significant metabolic demands, and stress a marginally compensated organ system.
- Anxiety caused by physical illness is usually suggested by the patient's physical findings but may require testing to further delineate the cause.
- Oral, intravenous, or intramuscular medication may be necessary for patients who are a significant threat to themselves or others and for anxious patients with significant medical illness.
- Limited benzodiazepine therapy may be helpful for select patients.

## CHAPTER 102: QUESTIONS &amp; ANSWERS

- 102.1.** Which of the following is the most common mental health disorder?
- Anxiety
  - Bipolar
  - Depression
  - Schizophrenia
  - Substance abuse

**Answer: A.** Many of these patients never receive appropriate care, in part because they choose to present with a physical complaint and disguise their anxiety. Patients with chronic illnesses have higher rates of anxiety and depression than the rest of the population.

- 102.2.** What is the most common cause of organic anxiety, anxiety that results from a physiologic origin?
- Adrenal disorders
  - Alcohol and drug use
  - Cardiac disease
  - Hyperthyroidism
  - Pulmonary embolus

**Answer: B.** This may be from intoxication or withdrawal states.

- 102.3.** A 52-year-old woman presents with 2 months of recurrent episodes of anxiety, mild chest pain, subjective palpitations, hand paresthesias, and occasional muscle spasms. They have occurred weekly in the past but are now increasing in frequency. Her only past history is a thyroidectomy 4 months prior. She is taking levothyroxine (Synthroid) and had normal thyroid levels 2 weeks ago. Her vital signs, physical examination, and electrocardiogram are normal. Laboratory evaluation shows sodium 141 mEq/L, potassium 4.1 mEq/L, creatinine 1.0 mg/dL, bicarbonate 26 mEq/L, chloride 100 mEq/L, and calcium 7.1 mg/dL; a complete blood count is normal. Which of the following should be the next step in her management?
- Outpatient clonazepam
  - Parathyroid hormone level
  - Psychiatry consultation
  - Thyroid hormone levels
  - Urine drug screen

**Answer: B.** Anxiety is the predominant symptom in 20% of patients with hypoparathyroidism. Other symptoms include paresthesia, muscle cramps, and spasms. Most cases are idiopathic or due to inadvertent parathyroid gland harvest during thyroidectomy. The diagnosis is suggested by a low serum calcium and an elevated phosphate and is confirmed by a depressed parathyroid level.

- 102.4.** Which of the following statements regarding anxiety and endocrine disorders is *true*?
- Anxiety can often be traced to reactive hypoglycemia.
  - Anxiety is not a manifestation of hypothyroidism.
  - Diabetics treated with antianxiety agents have improved hemoglobin A1c levels.
  - Less than 5% of diabetics experience anxiety.
  - Patterns of diaphoresis in pheochromocytoma mimic those of a panic attack.

**Answer: C.** Approximately 15% of diabetics have an anxiety disorder. Treatment improves hemoglobin A1c levels. Anxiety due to reactive hypoglycemia is rare despite the common perception among patients. Pheochromocytoma causes whole body diaphoresis, whereas panic disorders primarily cause sweaty palms. Hyperthyroidism or hypothyroidism can cause significant anxiety manifestations. It is more related to the rate of change than the level of thyroid hormones.

- 102.5.** A 23-year-old woman with a history of asthma presents with increasingly frequent episodes of panic attacks. Her medications are an inhaled beta-agonist and an intermittent steroid inhaler. She reports subjective increasing asthma severity as her panic episodes have worsened. When counseling the patient, which of the following statements is most correct?
- An anxiety disorder in an asthmatic patient does not increase morbidity.
  - Anxiety does not precipitate asthma attacks.
  - Anxiety does not worsen airflow.
  - Asthmatics are more likely to have an anxiety disorder.
  - It is difficult to differentiate dyspnea related to asthma from anxiety.

**Answer: D.** Anxiety can precipitate and prolong an asthma attack. Morbidity and mortality are increased in asthmatic patients who have a coexisting anxiety disorder. Patients who have asthma are twice as likely to have an anxiety disorder and five times as likely to have a phobia. Acute dyspnea from “panic” dyspnea can be differentiated from asthma by clear lungs on auscultation.

- 102.6.** Which of the following syndromes is not associated with anxiety?
- Left hemispheric strokes
  - Multiple sclerosis
  - Right hemispheric strokes
  - Transient ischemia attack
  - All of the above can be associated with anxiety.

**Answer: E.** Anxiety may be a component of seizures, tumors, arteriovenous malformations, and ischemic events. It may be the only manifestation of some disorders (eg, right hemispheric strokes and transient ischemic attacks [TIAs]). The coexistence of anxiety plays an important role in the prognosis and impairment of stroke patients.

**102.7.** A 38-year-old woman with a long history of anxiety and panic disorder presents with anhedonia, melancholy, sleep disruption, crying episodes, and some hostility feelings. She has no current anxiety symptoms. Her only medication is clonazepam. She has no known medical illness. Which of the following statements regarding this patient's symptoms is *true*?

- A. Approximately 50% of patients with panic disorder develop major depression.
- B. Depression with anxiety and hostility is usually refractory to treatment.
- C. The first diagnostic step should be a thyroid panel.
- D. The majority of patients with depression have panic attacks.
- E. This is likely a drug-induced depression.

**Answer: A.** Approximately 50% of patients with a primary panic disorder will later develop major depression. Twenty percent of patients with depression have panic attacks. Depression with panic attacks is less responsive to treatment, but depression with anxiety and hostility responds well to antidepressants. Although benzodiazepines can exacerbate symptoms of depression, there is already a high spontaneous rate of depression with anxiety disorders.

**102.8.** Which of the following statements regarding benzodiazepine use and anxiety is *true*?

- A. Benzodiazepines are first-line agents for anxiety disorders.
- B. Several weeks of treatment are indicated after initial diagnosis.
- C. Short-acting benzodiazepines produce a more severe abstinence syndrome.
- D. They are particularly useful in patients with alcohol abuse.
- E. Withdrawal rebound is less common than with selective serotonin reuptake inhibitors (SSRIs).

**Answer: C.** SSRIs are the first-line agents for anxiety and panic disorders, but the primary disadvantage is the several-week lag needed for maximal clinical benefit. Benzodiazepines work best for motivated, dependable patients when an immediate reduction of symptoms is indicated or a short-term treatment is necessary. Patients who do not benefit from benzodiazepines within a week are unlikely to do so. Patients with a history of alcoholism or drug abuse, who are excessively/emotionally dependent, or who become anxious from normal stress are at greater risk for dependency. Rebound withdrawal is more likely after short-acting agents.

**102.9.** A 29-year-old Caucasian female presents with excessive daytime somnolence. She states that she had been suffering from anxiety associated with her paralegal occupation, and 1 week ago her psychiatrist had started her on a 2-week course of once-daily benzodiazepine therapy, which she takes in the morning. Her anxiety symptoms are well controlled. She asks if you can change her to a new medication because the somnolence is significantly affecting her job

performance. What would be the most appropriate course of action?

- A. Counsel the patient that she should continue the medication as prescribed because she will soon adapt and the somnolence will likely subside.
- B. Discontinue the benzodiazepine and refer her back to her psychiatrist.
- C. Have her try dosing the benzodiazepine at bedtime, because this will likely continue to control her anxiety and limit daytime somnolence.
- D. Switch the patient to a selective serotonin reuptake inhibitor (SSRI) and refer her back to her psychiatrist.
- E. Switch the patient to a shorter-acting benzodiazepine.

**Answer: C.** Instituting an SSRI should be reserved for primary care physicians or psychiatrists who can monitor the patient more closely, because the response will be delayed. Some patients do adapt to the sedative effects of benzodiazepines but usually only after long-term use. Stopping the benzodiazepine may ultimately be necessary but at the risk of recurrent anxiety. Dosing benzodiazepines at bedtime may minimize daytime sedation and still provide an anxiolytic effect. Shorter-acting benzodiazepines produce a more severe abstinence syndrome when stopped abruptly, and thus most prescribers prefer longer-acting agents.

**102.10.** A 52-year-old male construction worker presents with chest pain. He states his symptoms began early this morning and have progressively worsened throughout the day. His symptoms include nervousness, tremors, chest pain, shortness of breath, and palpitations. He states that he has had anxiety for 30 years but has controlled it with the consumption of alcohol. He became unemployed 1 week ago, and his daily alcohol use has diminished significantly. His vital signs are blood pressure (BP) 185/95 mm Hg, heart rate 123 beats per minute, respiratory rate of 20 breaths per minute, and temperature of 98.9° F. His physical examination is remarkable for diaphoresis, tongue fasciculation, both resting and intention tremors, and mild psychomotor agitation while maintaining orientation with a congruent anxious mood and affect. What is the most likely etiology of this patient's symptoms?

- A. Acute alcohol withdrawal syndrome
- B. Exacerbation of endogenous anxiety secondary to diminished alcohol intake
- C. Exacerbation of exogenous anxiety secondary to change in employment status
- D. Hypertensive emergency with acute coronary syndrome
- E. Reactive anxiety secondary to the onset of chest pain

**Answer: A.** Hypertensive emergency is unlikely given the level of this patient's BP. On the basis of the history alone, it may be difficult to differentiate organic versus functional anxiety or identify an exogenous trigger, but the abnormal vital signs and physical examination associated with a recent cessation of long-term alcohol consumption makes acute alcohol withdrawal the most likely cause. Given the significant morbidity associated with withdrawal states, this must be addressed acutely. Appropriate diagnosis and management of underlying psychiatric disease will be a secondary concern after the patient's withdrawal is managed.



## KEY CONCEPTS

- Somatoform disorders as a diagnosis has been eliminated from the DSM-5 and reconceptualized with the category of SSDs.
- The patient with functional neurological symptom disorder, what was termed *conversion disorder* previously, requires a careful and complete neurological examination. Rather than miss the subtle presentation of a neurological disorder, it may be appropriate to perform imaging and obtain neurological and psychiatric consultation. Do not assume that the patient with neurological deficits has a psychiatric disorder.
- Success with the SSD patient depends on establishing rapport with the patient and legitimizing their complaints to avoid a dysfunctional physician-patient interaction.
- Avoid telling the SSD patient “it is all in your head” or “there is nothing wrong with you.” These patients are very sensitive to the idea that their suffering is being dismissed.
- A useful approach is to discuss recent stressors with the patient and suggest to them that at times our bodies can be smarter than we are, telling us with physical symptoms that we need assistance. This approach alone may transform the ED visit from a standoff between physician and patient, to a grateful patient who develops greater insight and is amenable to referral.
- Avoid prescribing unnecessary or addictive medications to the SSD patient.
- If you suspect a diagnosis of SSD, refer the patient to primary care or psychiatry for further evaluation and treatment.
- Evaluate and refer appropriately for any concurrent anxiety or depression; psychiatric consultation is needed in the setting of acute decompensation.
- Patients with SSD are best cared for by establishing an ongoing relationship with a primary care provider, and it is appropriate to stress this with the SSD patient.

## CHAPTER 103: QUESTIONS &amp; ANSWERS

**103.1.** Which of the following is most likely to occur from ordering of excessive diagnostic tests in patients with a somatic symptom disorder?

- A. A conclusive diagnosis
- B. An improved physician-patient relationship
- C. Morbidity from repeated diagnostic tests
- D. Patients who are reassured by excessive testing
- E. The exclusion of organic disease with absolute certainty

**Answer: C.** Repeated diagnostic testing in somatizing patients not only leads to excessive use of health care services and iatrogenic harm but, in addition, does not lead to increased patient satisfaction, decreased suffering, or improved physician-patient relationship. The most reasonable approach to the patient with a potential diagnosis of somatic symptom disorder is a rational search for biomedical causes along with an open discussion of psychosocial issues from the start of the patient encounter.

**103.2.** Which of the following is more likely in patients with recent-onset somatic disorder compared with patients with long-term somatic disorder?

- A. Anxiety
- B. Depression
- C. Grief reaction
- D. All of the above

**Answer: D.** Patients who present with the recent onset of somatization are more likely to have an acute psychological stressor that they are either unwilling or unable to directly report and may instead use somatic symptoms to legitimize their presentation to the emergency department. The diagnosis of somatization disorder requires multiple, recurrent, unexplained symptoms rather than an acute complaint in a single visit.

**103.3.** Which of the following approaches is the most appropriate for diagnosis and treatment of somatic symptom disorder?

- A. Confront the patient and explain that there is nothing “wrong.”
- B. Order multiple diagnostic tests.
- C. Proceed with the assumption that the patient is malingering.
- D. Refer the patient to insight-oriented psychotherapy.
- E. Use effective and appropriate communication skills.

**Answer: E.** Effective and appropriate communication skills are key to the diagnosis and treatment of patients with a somatic symptom disorder. These patients do not meet the criteria for factitious disorder or malingering. Patients with a somatic symptom disorder have reduced symptoms and improved functioning when the physician does not attempt to minimize the experience of symptoms with comments such as “It is all in your head.” In addition, these patients appear to derive very little benefit from insight-oriented psychotherapy; rather, they will maintain improved functional health status and require fewer physician visits if they have an ongoing and trust-based relation-

ship with the primary care physician.

**103.4.** A patient presents with the sudden onset of blindness, which cannot be explained medically. Which of the following is the most likely to be *true*?

- A. The condition is under the patient’s voluntary control.
- B. The patient is more likely to have preexisting eye disease.
- C. The patient is unlikely to have any comorbid diagnosis, such as mood disorder, panic disorder, or post-traumatic stress disorder.
- D. The presentation represents the patient’s own perception of neurologic illness.

**Answer: D.** Patients with a functional neurological disorder may present to the physician with what they believe represents a neurologic illness. They are likely to have an underlying comorbid diagnosis, such as mood disorder, panic disorder, or post-traumatic stress disorder. Interestingly, the presentation, such as blindness or paralysis of the lower extremities, is not under the patient’s voluntary control.

**103.5.** Which of the following statements regarding somatization disorder is *true*?

- A. A specific symptom may point to the diagnosis.
- B. More symptoms correlate with a higher likelihood of psychiatric illness.
- C. The symptoms may be feigned or voluntary.
- D. There is no direct association with anxiety.
- E. There is no direct association with depression.

**Answer: B.** Women with more than five symptoms and men with more than three symptoms have a much higher likelihood of psychiatric illness. The symptom complaints are neither feigned nor voluntary but, rather, more a manifestation of some sort of distress. There is an association with both depression and anxiety. It is the multiplicity rather than the specificity of symptoms that suggests the diagnosis.

**103.6.** Which of the following statements regarding chronic pain syndrome (pain disorder) is *true*?

- A. Chronic pain behavior patterns are fixed after 2 weeks.
- B. It may be intentionally feigned.
- C. It often follows a specific traumatic event.
- D. The pain is limited to the single organ system or injury.
- E. There is typically a pathophysiologic explanation for the pain.

**Answer: C.** Most cases of chronic pain follow a specific traumatic or industrial event. It is not intentionally feigned, usually involves more than one organ system, and limits function, and the degree of pain or incapacitation cannot be explained medically. Pain behaviors are typically fixed at 3 months, and failure to improve or to return to normal function at 2 weeks should raise concerns and prompt review.

## KEY CONCEPTS

- Patients who have consciously synthesized symptoms and signs may be divided into two broad diagnostic categories: (1) those with obvious secondary gain (malingering), who control their actions, and (2) those with a motivation of achieving the sick role (factitious disorders), who cannot control their actions.
  - The initial management of patients suspected of fabricating disease should include a caring, nonjudgmental attitude and a search for objective clinical evidence of treatable medical or psychiatric illness.
- Review of old medical records and interview of family members are often helpful.
- Unnecessary tests, medications, and hospitalizations should be avoided in the absence of objective evidence of a medical or psychiatric disease, and patients should be referred for ongoing primary care.
  - In cases of suspected FDIA involving children or elders, protection of the victim takes first priority.

## CHAPTER 104: QUESTIONS &amp; ANSWERS

**104.1.** Which of the following statements regarding factitious disorder is true?

- A. It involves voluntary and controllable symptom production.
- B. Patients are generally well educated and otherwise responsible.
- C. Presentations are not related to an identifiable event.
- D. The symptoms produced are always physical ones.
- E. The underlying motivation is a conscious one.

**Answer: B.** Many such patients are actually employed in the health care industry. The act of producing symptoms is voluntary but not controllable and derives from a subconscious motivation. Presentations are very often related to a “traumatic” event, such as a breakup. Produced symptoms may be physical (eg, hematuria) or psychological. The typical patient is an unmarried female younger than 40 years. Despite undergoing invasive procedures and associated hardships, these patients seek more medical care and hospitalization.

**104.2.** Which of the following statements concerning Munchausen syndrome by proxy is true?

- A. A known physical illness in the child is common.
- B. Most maternal perpetrators are demanding, uncooperative, and socially inept.
- C. Most maternal perpetrators are not a biologic parent.
- D. Psychosis is common in the maternal perpetrator.
- E. The mean age of victim diagnosis is 7 to 9 years.

**Answer: A.** Victim children often have a legitimate illness. Mean age at diagnosis is 40 months. Most have a history of failure to thrive and multiple hospitalizations. The perpetrator receives some personal fulfillment from the care and attention of the hospital staff, which is often admiration for her persistence, willingness to sacrifice and patience, and she is typically pleasant, medically savvy, and socially skilled. Invasive procedures on the child are often welcomed. Although psychosis is very unusual in the parent, depression, anxiety, and somatization are typical in the perpetrator.

**104.3.** A 2-year-old female presents with new onset seizures. Her past medical history is unremarkable. Laboratory

evaluation reveals blood glucose of 20 mg/dL. The patient’s mother denies a family history of diabetes or having medications the child might have ingested at home. She works as a nurse at a local hospital and has been with the child all day. The child’s symptoms improve with glucose administration and a meal. Your colleague remembers evaluating the child recently for hematuria with a negative evaluation. If you suspect Munchausen syndrome by proxy, which of the following tests would be most helpful in establishing the diagnosis?

- A. Basic metabolic panel
- B. Computed tomography (CT) scan of head
- C. C-peptide and insulin level
- D. Electroencephalography (EEG)

**Answer: C.** The diagnostic criteria for factitious hypoglycemia include high serum insulin levels along with the absence of serum C-peptide. The C-peptide is removed during the purification of commercial insulin, and so its absence suggests the presence of endogenously administered insulin. In patients with insulinoma, both C-peptide and insulin levels are elevated and detectable.

**104.4.** A prison inmate presents after falling from the top bunk in his cell. He is complaining of lower lumbar pain and states he is unable to move or feel his lower extremities from his waist down. On physical examination, lower extremity reflexes are present but the patient denies feeling pain or light touch sensation below the waist. Lumbar spine CT and MRI are negative. Which of the following conditions is most likely?

- A. Cord contusion
- B. Factitious disorder
- C. Malingering
- D. Munchausen syndrome

**Answer: C.** Malingering is the intentional symptom production for secondary gain. There is a marked discrepancy between claimed disability and the actual objective findings. Confessions and proof are rare.

## KEY CONCEPTS

- Suicide is a common—but preventable—cause of death.
- Suicidal thoughts or behaviors are often triggered by a treatable or reversible short-term crisis, and most attempt survivors are grateful to be alive.
- Suicide risk changes over time, and estimation of imminent risk is not evidence based at this time.
- Routine “screening” laboratories provide little value for most ED patients with self-harm behaviors. Evaluation should be directed at specific concerning signs or symptoms.
- Many suicidal individuals see a physician shortly before their death. An ED visit for suicidal thoughts or behaviors represents a crisis and a teachable moment.
- An empathetic, patient-centered, collaborative approach that incorporates information from collateral sources (eg, family) can optimize care.
- Suicide precautions in the ED include appropriate use of “sitters” and, when necessary, physical and chemical restraints and involuntary commitment.
- Brief risk assessment by the emergency clinician can identify patients in need of a comprehensive evaluation and consultation with a mental health specialist (if available).
- Patients at low risk of suicide may be discharged home to a safe and supportive environment without access to guns or toxic medications.
- Discharged patients should receive education and safety planning in the ED and should have early mental health follow-up appointment.

## CHAPTER 105: QUESTIONS &amp; ANSWERS

- 105.1.** Which of the following statements about suicide is true?
- Many suicide attempts occur during an acute crisis.
  - Suicide rates are highest in older men.
  - Suicidal behavior may be chronic.
  - Suicidal patients are usually ambivalent about dying.
  - All of the above are true.

**Answer: E.** Many suicide attempts occur in response to a crisis that may be time limited or resolvable. Suicide rates are particularly high in older white men. With the exception of psychotic patients, suicidal patients are usually ambivalent about dying. An example of chronic suicidal behavior is drinking in the face of liver disease.

- 105.2.** Which of the following statements about suicide is true?
- Blacks attempt suicide more than whites.
  - Men attempt suicide more than women.
  - Marriage decreases the likelihood of suicide.
  - Pregnancy increases the risk of suicide.
  - Suicide rates are highest among female teens.

**Answer: C.** Marriage and pregnancy/motherhood decrease suicide risk. Whites attempt suicide more than blacks, with the highest rate among older white men. Women attempt suicide far more often than men but do not choose lethal means and therefore have a lower success rate.

- 105.3.** Which of the following is a risk factor for suicide?
- Prior suicide attempt
  - Access to firearms
  - Alcohol abuse
  - Veteran status
  - All of the above

**Answer: E.** Additional suicide risk factors include, but are not limited to: adolescence and older age; male gender; certain races/ethnicities (White, American Indian, Alaskan Native); mental disorders; substance abuse; prior suicide attempt; psychosocial stressors (eg, recent psychiatric hospital discharge, history of trauma or abuse, terminal illness, chronic pain, hopelessness, impulsiveness); environmental stressors (eg, job loss, bereavement); and sociocultural factors (eg, isolation, poor access to mental health care, stigma against seeking help, or media exposure to suicide).

- 105.4.** Most completed suicides involve which of the following?
- Falls
  - Firearms
  - Piercing
  - Poisonings
  - Suffocation

**Answer: B.** Fifty percent of completed suicides involve firearms. Seventy percent of attempted suicides involve poisoning.

- 105.5.** Discharge planning for suicidal patients should include which of these elements?
- Counseling about reducing access to guns and toxic medications.
  - Involvement of family or friends.
  - Rapid referral to outpatient mental health.
  - Written materials with warning signs and hotline numbers.
  - All of the above.

**Answer: E.** All of the listed elements are recommended components of ED care and discharge planning for patients evaluated for suicidal thoughts or behaviors but deemed safe for discharge home.

- 105.6.** A 33-year-old Caucasian man presents with agitation and suicidal ideation. He has a long history of schizophrenia and is currently taking olanzapine and occasional clonazepam. He was hospitalized 3 weeks prior for an accelerated psychotic episode and released on an increased dose of olanzapine. His family brought him here today after visiting him in his apartment and finding him in a room with all the lights off. They note he has been unable to work for more than 2 years. He was formerly employed as an engineer. Your examination is remarkable for a blunted affect, moderate pressured speech, and a depressed mood. What is the most appropriate intervention?
- Addition of sertraline to olanzapine, 2-day follow-up
  - Admission to psychiatry unit
  - Increase olanzapine, release with family
  - Overnight emergency department (ED) observation, 2-day psychiatry follow-up
  - Parenteral ziprasidone, release with family

**Answer: B.** Approximately 10% of schizophrenic patients will kill themselves. Psychotic patients who kill themselves are often unmarried whites of high intelligence. A recent psychiatric hospitalization is a suicide risk factor, particularly during the first month post discharge. This patient is high risk and needs admission.

- 105.7.** Which of the following statements concerning risk assessment of suicidal patients is true?
- A.** An empathetic approach will reinforce malingering behavior and subsequent ED visits.
  - B.** For patients at low risk of imminent suicide, providers can consider discharge without formal consultation with a mental health professional.
  - C.** Intoxicated patients who, once sober, disavow prior suicidal statements do not need a suicide risk assessment.
  - D.** Routine screening labs should include serum chemistries and urine toxicologic panels.
  - E.** Suicidal patients can be permitted to leave the ED prior to a risk assessment as long as they sign "Against Medical Advice" paperwork.

**Answer: C.** In a step-wise manner, the ED provider can complete a brief risk assessment to identify which patients do (or do not)

require a comprehensive evaluation with a mental health professional. Diagnostic testing should be targeted to individual patients as clinical indicated. An empathetic approach can enhance patient evaluation and care and should be used with all suicidal patients. Acute and chronic alcohol use are both suicide risk factors; even if a patient denies suicidality once sober, a risk assessment may be prudent. No suicidal patient should be allowed to leave the ED before the risk assessment is complete.

- 105.8.** Which of the following statements about involuntary commitment is true?
- A.** It is not associated with adverse psychiatric consequences.
  - B.** It lowers the rate of future suicides.
  - C.** Most states mandate attempts at involuntary commitment if there is imminent self-harm.
  - D.** Patients who volunteer for admission may still need commitment papers.
  - E.** Statutes are consistent among the states.

**Answer: D.** Statutes vary widely among the states. Some states require commitment papers even in cases of voluntary admission. Only two states mandate commitment in the face of suspected imminent self-harm. Involuntary commitment does not lower the rate of future suicides and is associated with adverse psychiatric consequences.

## KEY CONCEPTS

- The most likely cause of emergency arthritis presentations can usually be identified by considering the number of joints involved (monoarticular versus polyarticular), the distribution of joint involvement (large versus small joints and symmetrical versus asymmetrical joint involvement), and the time course.
- The possibility of septic arthritis should be considered in all patients who present with acute monoarticular arthritis.
- There is no combination of examination findings or blood tests that places septic arthritis below the threshold for performance of arthrocentesis in adult patients presenting with a new, hot, swollen, painful joint. Synovial fluid analysis is necessary for risk stratification of septic arthritis, and delays in treatment worsen outcomes.
- The presence of crystals in synovial fluid or a negative Gram's stain result does not completely eliminate the possibility of septic arthritis. Bacterial arthritis can coexist with gout or pseudogout, and the result of Gram's stain is positive in only 50% to 80% of cases of septic arthritis.
- Many other common arthritides, such as gout, rheumatoid arthritis, and osteoarthritis, can be managed with NSAIDs as a first-line therapy. In those who cannot tolerate or have not improved with NSAIDs, systemic or intra-articular steroid therapy has been shown to have varying levels of support. Appropriate follow-up is crucial for prophylaxis against future flare-ups.

## CHAPTER 106: QUESTIONS &amp; ANSWERS

**106.1.** Which of the following typically presents with a monoarticular arthritis pattern?

- A. Drug-induced arthritis
- B. Gonococcal arthritis
- C. Pseudogout
- D. Reiter's syndrome
- E. Rheumatic fever

**Answer: C.** Other monoarticular processes are gout, septic arthritis, Charcot's joint, and hemarthrosis.

**106.2.** Which of the following typically presents with an asymmetrical polyarticular arthritis pattern?

- A. Gonococcal arthritis
- B. Lyme
- C. Systemic lupus erythematosus
- D. Viral arthritis
- E. All of the above

**Answer: E.** Acute rheumatic fever (ARF) does also.

**106.3.** You perform arthrocentesis of a knee joint because of concern for septic arthritis. Which of the following findings from joint fluid aspiration increase the likelihood of septic arthritis?

- A. Synovial lactate dehydrogenase (LDH) of 300 U/L
- B. Synovial lactate of 3.0 mmol/L
- C. Synovial whole blood cell (WBC) count of 12,000 cells/mm<sup>3</sup>
- D. Viscous aspirate

**Answer: B.** Synovial LDH levels above 250 U/L are sensitive for septic arthritis, whereas lower levels seem to exclude the diagnosis. Similarly, synovial lactate above 5.6 mmol/L is associated with higher likelihood for septic arthritis. Higher synovial WBC counts are directly proportional to the likelihood of a septic joint, but 12,000 cells/mm<sup>3</sup> is still on the low end of the spectrum.

**106.4.** A 53-year-old man presents with acute onset of right knee pain and swelling. He has a history of diabetes, hypertension, and gout. Physical examination is remarkable for a temperature of 39.6° C and a significant right knee effusion with warmth and significant tenderness to palpation and motion. Arthrocentesis yields a modestly turbid fluid with a white blood cell (WBC) count of 47,000 cells/mm<sup>3</sup> (mostly polymorphonuclear [PMN] cells), few urate crystals, and negative Gram's stain. Serum erythrocyte sedimentation rate (ESR) is 63 mm/hr. What should be the next step in this patient's management?

- A. Admission for observation and analgesics
- B. Intravenous (IV) antibiotics and orthopedics consult for admission
- C. Outpatient clindamycin, hydrocodone, indomethacin
- D. Outpatient colchicine, ice, elevation, hydrocodone
- E. Outpatient ice, elevation, hydrocodone, indomethacin

**Answer: B.** Differentiation of septic arthritis from a flare of a known inflammatory arthritis is difficult because the two can occur in synchrony. Joint fluid WBC counts may be low or high in either, with even WBC counts of 25,000 having an odds ratio for infection of 0.3. There is a predominance of PMN neutrophils in both. With septic arthritis, Gram's stain is positive in only 50% to 70% of cases, so ultimately neither WBC or Gram's stain can rule out a case. Fever is likewise present in both circumstances. In this patient with diabetes and a chronically abnormal joint, empirical treatment as for a septic joint is safest.

**106.5.** A 54-year-old postmenopausal woman presents with acute onset of right ankle pain. She denies injury or preceding illness. Her past history is remarkable for obesity, nephrolithiasis (one episode), and hypertension that is controlled by a thiazide diuretic. Her examination is remarkable for a low-grade temperature and a tender, warm right ankle effusion requiring use of a wheelchair. Which of the following statements regarding this patient's condition is *true*?

- A. A radiograph will be diagnostic.
- B. A response to colchicine is diagnostic.
- C. Corticosteroids may be useful.
- D. Her uric acid level will likely be elevated.
- E. Indomethacin has unique efficacy for this process.

**Answer: C.** Gout develops in men and postmenopausal women. Most patients probably had chronically elevated uric acid levels for years before clinical gout and may have had renal stones or musculotendinous problems due to urate disposition. Uric acid levels may actually normalize during acute attacks and are of no benefit (like radiographs). Both gout and pseudogout (also a crystalline deposition disease) respond to colchicines via similar mechanisms. Indomethacin is no better than any other nonsteroidal antiinflammatory drug (NSAID). Corticosteroids may be particularly useful in cases in which renal or gastrointestinal (GI) considerations contraindicate colchicines and/or NSAIDs. A common regimen is corticotropin (adrenocorticotrophic hormone [ACTH]) 40 to 80 international units intramuscularly as a single dose.

**106.6.** Which of the following findings is consistent with osteoarthritis?

- A. Lack of hand involvement
- B. Morning stiffness lasting 2 or 3 hours
- C. Subchondral bone cysts on radiographs
- D. Systemic symptoms
- E. Synovial white blood cell (WBC) count greater than 2000 cells/mm<sup>3</sup>



**Answer: C.** This is seen along with osteophytes and joint space narrowing. Systemic symptoms and prolonged morning stiffness suggest rheumatoid arthritis. Synovial WBC count is generally less than 2000 cells/mm<sup>3</sup>. Symmetrical and sometimes isolated/severe hand involvement at the proximal interphalangeal (PIP) joint (Bouchard's nodes) and distal interphalangeal (DIP) joint (Heberden's nodes) may be seen.

- 106.7.** A 34-year-old man presents with complaints of bilateral knee swelling. He describes several weeks of diffuse transient migratory myalgias and arthralgias with mild generalized fatigue. During the past 10 days, he developed swelling in his right knee to a greater extent than the left. He has no past medical history and normally takes no medications. He does not recall a rash. He does not use alcohol or tobacco and works as a park ranger. Physical examination reveals bilateral large knee effusions. Which of the following statements regarding this patient's condition is *true*?
- A. Careful inspection should reveal a rash.
  - B. Fever is expected.
  - C. Immunoglobulin M and G studies are indicated.
  - D. Joint pain parallels the size of the effusions.
  - E. Synovial fluid cultures should be diagnostic.

**Answer: C.** Lyme disease presents in an insidious manner. The classic rash (erythema migrans) often goes unnoticed. This is followed by a pattern of migratory myalgias and arthralgias. Joint effusions are large, not very painful, and culture negative because of the difficulty culturing *Borrelia* species.

- 106.8.** A 47-year-old woman presents with fatigue and joint pain. She describes a 3-month history of fatigue, morning stiffness, and bilateral hand, foot, and elbow stiffness that improves somewhat over the course of the day. Laboratory evaluation reveals a normocytic anemia with a white blood cell (WBC) count of 11,300 cells/mm<sup>3</sup>. She localizes most of her daily pain to the knuckles of both hands. Which of the following statements regarding this patient's condition is *true*?
- A. Acute pericarditis only occurs after long-standing disease.
  - B. C1 to C2 instability is unlikely.
  - C. Finger distal interphalangeal (DIP) joints should reveal painful swelling.
  - D. The joint pain is typically migratory.
  - E. The presence of foot pain is not expected.

**Answer: B.** This presentation for rheumatoid arthritis is fairly typical. C1 to C2 instability due to transverse ligament degeneration is only after long-standing disease. Pericarditis, however, may occur as an acute presentation or chronically. More than 90% of rheumatoid arthritis patients develop foot pain, classically in the first and fifth metatarsophalangeal (MTP) joints. The joint pain is progressive and additive—not migratory.

## KEY CONCEPTS

**Tendinopathy**

- Mechanical overload and repetitive microtrauma are key underlying mechanisms in the development of tendinopathy. Patients most often present with a history of progressively worsening localized pain after work- or sports-related activities that are repetitive in nature.
- Tendinopathy may also be associated with non-mechanical causes, including systemic manifestations of diseases, infectious etiologies, and the use of fluoroquinolones.
- Most patients with tendinopathy can initially be treated with conservative measures, such as protection, relative rest, application of ice, medications, and elevation. Overuse syndromes can take at least 6 to 12 weeks to heal. Inform patients of this, and provide an appropriate referral for follow-up.
- Emergent imaging is rarely indicated in the ED, although the use of bedside ultrasound to evaluate tendinopathy can help to identify tendon disruption/rupture.
- Operative treatment may be indicated for selected cases of tendon injury that require primary repair (eg, rupture of the Achilles tendon) or that have failed to respond to conservative treatment

(eg, impingement syndrome) and are amenable to surgical amelioration.

**Bursitis**

- Consider the possibility of an infectious cause in all cases of acute bursitis.
- The definitive diagnosis of bursitis is made by aspiration of the bursa and evaluation of the fluid.
- Septic bursitis is most commonly caused by *Staphylococcus aureus*.
- Nonseptic bursitis may be traumatic, rheumatologic (eg, gout and pseudogout), or idiopathic in nature. Other conditions, such as septic arthritis, osteomyelitis, and an underlying fracture, are in the differential diagnosis of bursitis.
- The management of bursitis includes treatment with appropriate medication (antibiotics for septic bursitis, NSAIDs for nonseptic bursitis), rest, application of ice, compression, and elevation, as well as prompt referral for appropriate follow-up. Hospitalization is considered for severe local infections, for patients who are immunosuppressed, and in the presence of high fever or systemic toxicity.

## CHAPTER 107: QUESTIONS &amp; ANSWERS

- 107.1.** Work-related injuries may be associated with which of the following?
- A. Awkward working postures
  - B. Forceful exertions
  - C. Repetitive motions
  - D. All of the above

**Answer: D.** Repetitive motions, forceful exertions, awkward working postures, whole body or segmental vibrations, and localized contact stress can all contribute to work-related injuries.

- 107.2.** What is the etiology of most tendinopathies?
- A. Direct blow to the tendon
  - B. Following complete tendon rupture
  - C. High-grade inflammation of the tendon
  - D. Mechanical overload and repetitive microtrauma

**Answer: D.** Tendinopathies are thought to be mainly precipitated by repetitive microtrauma and mechanical overload rather than true inflammation of the tendon.

- 107.3.** What is the causative organism in the majority of cases of septic bursitis?
- A. Beta-hemolytic streptococci
  - B. *Pseudomonas aeruginosa*
  - C. *Prototheca wickerhamii*
  - D. *Staphylococcus aureus*

**Answer: D.** *S. aureus* is the most common cause of infectious bursitis.

- 107.4.** What is the most important predisposing factor in septic bursitis?
- A. Chronic obstructive pulmonary disease
  - B. Diabetes mellitus
  - C. Human immunodeficiency virus
  - D. Trauma

**Answer: D.** Trauma is the most common predisposing factor in patients who develop septic bursitis.

- 107.5.** A 52-year-old male presents after feeling a “pop,” followed by pain to the back of his leg while playing basketball. You note a defect to his Achilles tendon and a positive Thompson’s test on examination. What should be the next step in the patient’s management?
- A. Obtain an ultrasound in the emergency department (ED).
  - B. Obtain a magnetic resonance imaging (MRI) scan in the ED.
  - C. Perform a steroid injection to the affected tendon.
  - D. Splint the affected leg in an equinus position and refer for prompt follow-up with orthopedics.

**Answer: D.** Although ultrasound and MRI can be important adjuncts to the diagnosis of a tendon injury, obtaining these tests from the ED is not necessary when the clinical diagnosis is obvious. Treatment consists of splinting the leg and close follow-up for either operative or nonoperative treatment.

- 107.6.** A 42-year-old female with no significant past medical history presents with 4 days of edema, mild warmth, and mild erythema in the area of the right olecranon bursa. She is afebrile and has minimal tenderness to palpation of the bursa. You aspirate the bursa and obtain a whole blood count of 1500/ $\mu$ L.<sup>3</sup> What should be the next step in the patient’s management?
- A. Admit for intravenous (IV) antibiotics.
  - B. Apply a compression dressing and give ibuprofen.
  - C. Discharge the patient to home with oral antibiotics.
  - D. Obtain a magnetic resonance imaging (MRI) scan for further evaluation.

**Answer: B.** The clinical presentation and results of the fluid analysis highly suggest a nonseptic bursitis. Cases of nonseptic bursitis can be managed with a compression dressing, nonsteroidal antiinflammatory drugs (NSAIDs), avoidance of local trauma, and follow-up.

## KEY CONCEPTS

## Systemic Lupus Erythematosus

- Systemic lupus erythematosus (SLE) may affect any organ system. Thus, a fundamental understanding of the disease is required to tailor the differential diagnosis and evaluation.
- A 50-fold increased risk of coronary artery disease (CAD) and up to a 30-fold increased risk of venous thromboembolism in patients with SLE prompt chest pain evaluations in the emergency department (ED), even in young women.
- An elevated C-reactive protein level is more closely linked to infection in SLE patients and is not reflective of SLE disease activity.
- An isolated elevated partial thromboplastin time (PTT) in a patient with SLE prompts consideration for antiphospholipid (aPL) antibody carrier state and, if there is a history of thrombosis, antiphospholipid syndrome (APS).
- Steroids are the mainstay for management of the majority of conditions that are associated with increased SLE disease activity, including musculoskeletal, cutaneous, renal, pleural, and pericardial disease.

- APS is common in patients with SLE and carries with it a risk of venous (typically deep venous thrombosis or pulmonary embolism) and arterial (most commonly stroke) thrombosis.
- Consultation with a rheumatologist may be helpful in diagnostic, management, and disposition decisions for patients with SLE.

## Vasculitides

- Vasculitis syndromes should be considered in the presence of systemic symptoms, such as fever, malaise, and weight loss plus pulmonary, renal, or cutaneous manifestations.
- Massive hemoptysis and acute renal failure can occur in Wegener's granulomatosis, Goodpasture's disease, microscopic polyangiitis, and Churg-Strauss syndrome. Tracheal stenosis may be present in Wegener's granulomatosis, further complicating airway management.
- Many patients with established vasculitis are receiving high-dose or combination immune suppressive therapy, making them vulnerable to opportunistic infections and overwhelming sepsis.

## CHAPTER 108: QUESTIONS &amp; ANSWERS

**108.1.** Which of the following statements is true regarding tinea capitis?

- A. It is markedly contagious.
- B. It is not transmitted by household pets.
- C. Prednisone is contraindicated for the treatment.
- D. Topical treatment is effective.
- E. Treatment generally lasts 2 to 4 weeks.

**Answer: A.** Tinea capitis is the dermatophytosis that is markedly contagious. Systemic treatment for 4 to 6 weeks is the minimum. It may be transmitted by pets. When a kerion develops, prednisone (along with the antifungal) should be used to decrease inflammation and scarring.

**108.2.** A 16-year-old male presents with complaints of a chronic recurrent pruritic rash. It has primarily presented in joint flexor areas and first began at approximately 2 years old. His only other past history is asthma and hay fever. Physical examination reveals bilateral antecubital and popliteal papulovesicular lichenification and hyperpigmentation. It is intensely pruritic. Which of the following statements is true?

- A. Adult-onset disease is common.
- B. Corticosteroids are contraindicated.
- C. Increased immunoglobulin E (IgE) levels are expected.
- D. More frequent exacerbations are expected in the summer.
- E. Skin changes are confined to the flexor areas of involvement.

**Answer: C.** This patient meets almost all criteria for atopic dermatitis. Onset after 5 years old should raise the question of an alternative diagnosis. The mechanism is believed to be eosinophil, mast cell, and lymphocyte activation by T cell production of interleukin-4. Elevated IgE levels are expected. Diffuse skin dryness is another prominent finding. Exacerbations may be triggered by increased body heat or stress, but they are more common in winter. Corticosteroids are the treatment mainstay.

**108.3.** A 29-year-old inmate presents with recurrent skin abscesses. Previous cultures have documented methicillin-resistant *Staphylococcus aureus* (MRSA) as the causative agent. It is resistant to clindamycin and sulfonamides. Which of the following antibiotics should be used for this case?

- A. Cephalexin
- B. Ciprofloxacin
- C. Erythromycin
- D. Linezolid
- E. Rifampin

**Answer: D.** MRSA is typically resistant to cephalosporins, macrolides, and fluoroquinolones. Rifampin is effective but should not be used as the sole agent due to rapid development of resistance.

**108.4.** A 23-year-old male presents with nonpurulent cellulitis of his left leg. There is no obvious abscess. He has no other medical problems. Which of the following should be the antibiotic of choice?

- A. Amoxicillin-clavulanate
- B. Ciprofloxacin
- C. Clindamycin
- D. Doxycycline
- E. Trimethoprim-sulfamethoxazole

**Answer: C.** Nonpurulent cellulitis is typically caused by staphylococcus or group A streptococcus. Group A streptococcus is typically resistant to bactrim and tetracycline/doxycycline. The potential for methicillin-resistant *Staphylococcus aureus* (MRSA) would obviate the use of amoxicillin and clavulanate potassium (Augmentin) or ciprofloxacin.

**108.5.** What is the parenteral treatment of choice for severe invasive *S. aureus* infection?

- A. Bactrim
- B. Clindamycin
- C. Rifampin
- D. Vancomycin
- E. Vancomycin and another antistaphylococcal agent

**Answer: E.** The combination is likely more effective due to enhanced bactericidal potential. Clindamycin and rifampin are not indicated as parenteral monotherapy.

**108.6.** Which of the following statements is true regarding gonococcal dermatitis?

- A. It affects primarily men.
- B. It occurs in 1% or 2% of patients with gonorrhea.
- C. Gonococci can usually be cultured from the lesions.
- D. The lesions have a predilection for the knees and elbows.
- E. The skin lesions are not tender.

**Answer: B.** Women are affected primarily. The lesions have a predilection for distal joint skin. They begin as red or hemorrhagic papules that evolve into pustules or vesicles with a red base. They are tender and may be confused with meningococcemia. They may later have a gray necrotic or hemorrhagic center. Skin cultures are usually negative.

**108.7.** Which of the following statements is *true* regarding drug eruptions?

- A.** A given drug produces a consistent eruption in the same patient.
- B.** A late-appearing drug reaction would suggest thiazide use.
- C.** Drug reactions tend to appear within 24 hours of drug initiation.
- D.** The most common cause of drug reactions are nonsteroidal antiinflammatory drugs (NSAIDs) and sulfa-based drugs.
- E.** The most common eruptions are urticaria and rashes.

**Answer: E.** The most common drug eruptions are urticaria and morbilliform rashes. Drug eruptions tend to occur within a week of drug initiation with the exception of semisynthetic penicillins, which tend to occur later. Penicillin is the most common cause of drug reactions, and patients with eczema, atopy, or asthma are at increased risk. A given drug may give widely diverse presentations in different patients or in the same patient on different occasions.

## KEY CONCEPTS

- Anaphylaxis is a life-threatening systemic allergic or non-allergic reaction of acute onset and multiorgan involvement; timely recognition and treatment are essential to maximize good outcomes.
- A history of sudden urticarial rash accompanied by respiratory difficulty, abdominal pain, or hypotension, strongly favors the diagnosis of anaphylaxis.
- Epinephrine is the first line treatment in patients with anaphylaxis and should be given immediately.
- There are no absolute contraindications to the use of epinephrine in the setting of anaphylaxis.
- Antihistamines and corticosteroids are second- and third-line agents in the management of anaphylaxis and should not replace or precede epinephrine.
- Consider prolonged observation or admission for patients who (1) experience protracted anaphylaxis, hypotension, or airway involvement; (2) receive IV epinephrine or more than two doses of IM epinephrine; or (3) have poor outpatient social support.
- Patients discharged after an anaphylactic event should be prescribed an EpiPen and instructed on its use, encouraged to develop an emergency action plan, and be referred for appropriate medical follow-up.
- Patients with refractory hypotension may require glucagon (receiving beta-blockage) or a continuous IV epinephrine infusion.
- Non-histaminergic angioedema (nonallergic angioedema) does not typically respond to epinephrine and antihistamines. New drugs, including berinert, icatibant, ecallantide, and Ruconest have been approved for use in HAE. FFP has been used with varying success in HAE, ACID, and ACE inhibitor-induced angioedema.

## CHAPTER 109: QUESTIONS &amp; ANSWERS

**109.1.** Which of the following statements regarding anaphylaxis is true?

- A. Atopy is a risk factor for parenteral allergens.
- B. Food is the cause in less than 10% of cases.
- C. Race and geographic locations are predisposing factors.
- D. Radiocontrast media (RCM) occurs in 5% of administrations.
- E. The cause is unidentified in 30% of cases.

**Answer: E.** Food is the cause in one-third of cases, and the cause is not identified in one-third of cases. Race and geography do not predispose. Atopy predisposes to mucosally, but not parenterally, administered allergens. RCM reactions occur in 0.22% of cases, given the hyperosmolar agents, but in only 0.04% of cases using nonionic media.

**109.2.** The majority of the clinical features of anaphylaxis syndrome are produced by which mediator?

- A. Acetylcholine
- B. Histamine
- C. Leukotrienes
- D. Prostaglandins
- E. Tumor necrosis factor

**Answer: B.** All contribute, but histamine is the predominant chemomediator.

**109.3.** A 31-year-old man has a history of anaphylaxis to penicillin. His condition warrants administration of a cephalosporin. Which of the following is true?

- A. A history of penicillin-induced urticaria carries no cross-reactivity risk.
- B. An oral cephalosporin given under supervision is acceptable.
- C. Most patients with a penicillin allergy history have a true penicillin allergy.
- D. Oral and parenteral cephalosporins carry equal risks.
- E. The risk of cephalosporin anaphylaxis is 5% to 10%.

**Answer: B.** Cephalosporin anaphylaxis after penicillin anaphylaxis is very rare (<1%). Parenteral agents carry a higher risk. Oral cephalosporins are likely to be safe. Penicillin-induced urticaria is a risk factor for an increased likelihood of a cephalosporin allergy. Most patients who report a penicillin allergy can safely use penicillin. Both penicillins and cephalosporins are haptens; they require cross-linkage with a host protein to become antigenic.

**109.4.** A 26-year-old 70-kg man is undergoing a Bier block for fracture reduction of a right distal radius fracture. Lidocaine 350 mg is used. Three minutes after drug injection, the patient develops wheezing, facial flushing, and mucosal edema. Which of the following statements regarding this scenario is true?

- A. Benzodiazepines are the treatment of choice.
- B. Bupivacaine was probably inadvertently substituted for lidocaine.
- C. Latex allergy to the tourniquet is the most likely etiology.
- D. Lidocaine toxicity is the most likely etiology.
- E. This is a methylparaben reaction.

**Answer: E.** Local anesthetic allergies are rare. Systemic effects are not. Many authors doubt that allergies to the amide anesthetics even occur. Methylparaben is a preservative in multidose vials that is structurally related to ester local anesthetics and can produce allergic reactions. Latex allergies are usually of slower onset and mild. Lidocaine toxicity would generally present with central nervous system (CNS) activation and seizures. Bupivacaine toxicity would present as hypotension and then cardiac collapse. Benzodiazepines may be indicated for lidocaine toxicity, not for signs of anaphylaxis.

**109.5.** Which of the following statements regarding radiocontrast media (RCM) reactions is true?

- A. A 12-hour delay in scanning may be warranted to allow adequate steroid dosing.
- B. Only H<sub>1</sub> receptor blockers are likely to have a prophylactic effect.
- C. Shellfish allergy is a contraindication to RCM use.
- D. The pathophysiology of RCM anaphylaxis is immunologically mediated.
- E. The specific RCM used has little bearing on the risk of anaphylaxis.

**Answer: A.** A delay may be necessary to allow adequate steroid dosing. Nonionic, lower weight agents have a far lower incidence of allergic reactions. Shellfish allergy has no bearing or effect. The mechanism of RCM allergy is nonimmunologic and likely involves direct histamine release and complement activation.



- 109.6.** A 27-year-old woman presents with the acute onset of pruritus, followed by flushing, dyspnea, and vomiting. Physical examination is remarkable for urticaria, tachypnea, tachycardia, hypotension, and bronchospasm. Which of the following statements regarding diagnosis of the patient's condition is true?
- Collection of vomitus may be indicated.
  - Histamine levels are useful if obtained within 6 hours.
  - Serotonin levels will not be useful.
  - Scombroidosis is possible.
  - Tryptase levels will not be useful.

**Answer: A.** Collection of vomitus may allow an allergist to customize an allergen provocation test. If drawn within 1 hour and 6 hours, histamine and tryptase levels, respectively, may help support the diagnosis of anaphylaxis. Elevated serotonin levels would indicate carcinoid. Scombroid poisoning, although histamine mediated, does not cause urticaria.

- 109.7.** What is the appropriate dose of epinephrine for treatment of acute anaphylaxis?
- 0.3–0.5 mg IM of 1:1000 concentration in anterolateral thigh
  - 1 mL of 1:1000 epinephrine intravenously
  - 5 mL of 1:10,000 epinephrine locally at the reaction site
  - 2 mL of 1:10,000 epinephrine intravenously every 5 minutes
  - 10 mL of 1:10,000 epinephrine over 10 minutes intravenously

**Answer: A.** Please refer to [Box 109.7](#).

## BOX 109.7

### Treatment Algorithm for Anaphylaxis

#### EMERGENCY MEASURES (TAKEN SIMULTANEOUSLY)

Remove any triggering agent.  
Place patient in supine position.  
Begin cardiac monitoring, pulse oximetry, and blood pressure autonomic monitoring.  
Begin supplemental oxygen if indicated.  
Establish large-bore IV lines (eg, 16 or 18 gauge).  
Establish a patent airway.  
Be prepared for endotracheal intubation with or without rapid sequence intubation.  
Be prepared to use adjunct airway technique (eg, awake fiberoptic intubation, surgical airway).  
Start rapid infusion of isotonic crystalloid (normal saline):  
Adults: 1000 mL IV in the first 5 minutes in the adult (several liters of normal saline may be required)  
Pediatrics: 20 to 30 mL/kg IV increments

#### ANAPHYLAXIS TREATMENT MEDICATIONS

##### First-Line Agent

Epinephrine is the first-line medication and should be given immediately at the first suspicion of an anaphylactic reaction.

Adult: 0.3 to 0.5 mg IM (1:1000 concentration) in anterolateral thigh every 5 to 10 minutes as necessary

Pediatric: 0.01 mg/kg IM (1:1000 concentration) in anterolateral thigh every 5 to 10 minutes as necessary

Alternatively, epinephrine (EpiPen, 0.3 mL; or EpiPen Jr, 0.15 mL) can be administered into anterolateral thigh

##### Second-Line Agents (Should Not Precede the Administration of Epinephrine)

###### Antihistamines

Diphenhydramine:

Adults: 50 mg IV or 50 mg oral

Pediatric: 1 mg/kg IV or oral

Ranitidine:

Adult: 50 mg IV (150 mg oral)

Pediatric: 1 mg/kg IV or oral

#### Aerosolized Beta-Agonists (if Bronchospasm Is Present)

Adult:

Albuterol: 2.5 mg, diluted to 3 mL of normal saline; may be given continuously

Ipratropium: 0.5 mg in 3 mL of normal saline; repeat as necessary

Pediatric:

Albuterol: 2.5 mg, diluted to 3 mL of normal saline; may be given continuously

Ipratropium: 0.25 mg in 3 mL of normal saline; repeat as necessary

#### Glucocorticoids (No Benefit in the Acute Management)

Methylprednisolone:

Adult: 125 to 250 mg IV

Pediatric: 1 to 2 mg/kg IV

Prednisone/prednisolone:

Adult: 40 to 60 mg oral

Pediatrics: 1 to 2 mg/kg oral

#### REFRACTORY HYPOTENSION

Consider continuous IV epinephrine drip (dilute 1 mg (1 mL 1:1000) in 1000 mL of normal saline or D<sub>5</sub>W to yield a concentration of 1 µg/mL)

Adults: 1 to 10 µg/minute IV (titrated to desired effect)

Pediatrics: 0.1 to 1.5 µg/kg/minute IV (titrated to desired effect)

#### OTHER VASOPRESSORS TO CONSIDER

Dopamine: 5 to 20 µg/kg per minute continuous IV infusion (titrated to desired effect)

Norepinephrine: 0.05 to 0.5 µg/kg per minute (titrated to desired effect)

Phenylephrine: 1 to 5 µg/kg per minute (titrated to desired effect)

Vasopressin: 0.01 to 0.4 units/min (titrated to desired effect)

#### PATIENTS RECEIVING BETA-BLOCKADE

Glucagon: 1 to 5 mg IV over 5 minutes, followed by 5 to 15 µg/min continuous IV infusion

## KEY CONCEPTS

- Accurate descriptions of the lesion(s) are essential for accurate diagnosis and management.
- Key steps in diagnosing the unknown rash include an accurate history, physical examination, including lesions and distribution, and appropriate diagnostic tests. Bacterial infections may present as abscess, cellulitis, impetigo, or other cutaneous infections.
- Incision and drainage is adequate therapy for simple abscesses.
- Antibiotics to cover MRSA are appropriate for most skin and soft tissue infections.
- Tinea capitis requires 4 to 8 weeks of systemic antifungal treatment.
- Onychomycosis requires long-term systemic treatment.
- Allergic reactions are common. Identification and removal of exposure to the allergen, and antihistamine treatment are the cornerstones of therapy.
- Newer nonsedating antihistamines are a useful alternative to older sedating ones to control pruritus and histamine-mediated rashes while allowing the patient to remain active.
- Infestations should be diagnosed clinically and treated expeditiously even without definitive proof of the infestation.
- Medication reactions are common and may result from any medication, typically within 4 to 21 days after taking the medication.
- Rashes that are associated with mucosal lesions, blisters, or desquamating skin are often caused by significant soft tissue infections, drug eruptions, or immune disorders.
- Patients with Stevens-Johnson syndrome and toxic epidermal necrolysis require inpatient treatment, preferably in a burn unit.
- Cutaneous signs of systemic disease may include pruritus, urticaria, erythema multiforme, erythema nodosum, pyoderma gangrenosum, and others.
- Physicians should be familiar with one or two topical steroid preparations of low, medium, and high potency and their appropriate therapeutic use.
- Most patients with dermatologic conditions can be appropriately managed with outpatient treatment and follow-up with a dermatologist. Life-threatening conditions at risk for dehydration and infection require inpatient treatment.

## CHAPTER 110: QUESTIONS &amp; ANSWERS

**110.1.** Which of the following statements regarding tinea capitis is TRUE?

- A. It is contagious.
- B. It is not transmitted by household pets.
- C. Tinea capitis presents with alopecia with normal underlying scalp.
- D. Topical treatment is effective.
- E. Treatment should be instituted for 1–2 weeks.

**Answer: A.** Tinea capitis is the dermatophytosis that is contagious. Systemic treatment for 4 to 6 weeks is the minimum. It may be transmitted by pets. The underlying scalp is typically inflamed.

**110.2.** A 16-year-old boy presents with an erythematous swelling of his left forearm. What is the appropriate initial antibiotic?

- A. Azithromycin
- C. Clindamycin
- B. Ceftriaxone
- D. Linezolid
- E. Penicillin VK

**Answer: C.** Clindamycin or trimethoprim-sulfamethoxazole are recommended first line treatment choices. Macrolides and penicillins are often ineffective against MRSA. Linezolid, although effective, is expensive and is not recommended as a first line treatment.

**110.3.** What is the causative organism of erythema migrans?

- A. *Borrelia burgdorferi*
- B. Group A *Streptococcus*
- C. Methicillin-resistant *Staphylococcus aureus*
- D. *Neisseria meningitidis*
- E. Parvovirus B-19

**Answer: A.** *Borrelia burgdorferi* is the causative agent of erythema migrans, or Lyme disease. Treatment should be instituted with doxycycline for 10–21 days, or as alternates, cefuroxime, ceftriaxone, or penicillin G. Group A *Streptococcus* is the causative organism of scarlet fever. *Neisseria meningitidis* is the causative agent of Meningococcemia. *Parvovirus B-19* is the causative agent of erythema infectiosum.

**110.4.** A 26 year old man presents with an erythematous maculopapular eruption of his torso, palms, and soles. He had a painless lesion on his penis 1 month earlier. What is the treatment of choice?

- A. Azithromycin
- B. Benzathine penicillin G
- C. Ceftriaxone
- D. Doxycycline
- E. Trimethoprim-sulfamethoxazole

**Answer: B.** Secondary syphilis is treated with benzathine penicillin G in a dose of 2.4 million units IM.

**110.5.** A 25 year old female presents with fever, migratory polyarthralgias, and hemorrhagic papules on her fingers and wrists. What is the best treatment?

- A. Ceftriaxone
- B. Ciprofloxacin
- C. Doxycycline
- D. Ofloxacin
- E. Vancomycin

**Answer: A.** Treatment of disseminated gonococcal infection is with parenteral ceftriaxones, or ceftizoxime or cefotaxime. Patients allergic to  $\beta$ -lactam antibiotics or those with severe penicillin allergies may be treated with spectinomycin. Ciprofloxacin and ofloxacin are not recommended because of increasing resistance patterns. Hospitalization is recommended for patients with disseminated gonococcal infection.

**110.6.** Which of the following statements regarding gonococcal dermatitis is TRUE?

- A. Gonococci can usually be seen on gram stain from the lesions.
- B. It affects primarily men.
- C. It occurs in 1% or 2% of patients with gonorrhea.
- D. The lesions have a predilection for the knees and elbows.
- E. The skin lesions are not tender.

**Answer: C.** Women are affected primarily. The lesions have a predilection for distal joint skin. The lesions are often multiple and have a predilection for periarticular regions of the distal extremities. The lesions begin as erythematous or hemorrhagic papules that evolve into pustules and vesicles with an erythematous halo. They may be tender and may have a gray necrotic or hemorrhagic center. The organism may be cultured from the cutaneous lesions. Gram stain only occasionally reveals the organisms.

**110.7.** A 30 year old man presents with headache, nausea and vomiting, myalgias, fever, and a rash of petechiae on the extremities and trunk. Lesions are clustered on the palms and soles. What is the best treatment?

- A. Cephalexin.
- B. Doxycycline.
- C. Erythromycin.
- D. Penicillin VK.
- E. Trimethoprim-sulfamethoxazole.

**Answer: B.** Patients with Rocky Mountain Spotted Fever present with headache, nausea and vomiting, myalgias, chills, and fever. The disease may last 3 weeks and may be severe with prominent involvement of the central nervous system, cardiac, pulmonary, gastrointestinal and renal systems, disseminated intravascular coagulation, or shock. The rash begins with erythematous macules that blanch on pressure, appearing first on the wrists and ankles. These macules spread up the extremities and to the trunk and face. They may become petechial or hemorrhagic. Lesions on the palms and soles are particularly characteristic. Doxycycline is the antibiotic of choice. Chloramphenicol may be used for patients allergic to tetracyclines and in children younger than 9 years. Sulfa drugs should be avoided because they may exacerbate the illness. *Rickettsiae* are routinely resistant to penicillins, cephalosporins, aminoglycosides, and erythromycin.

## KEY CONCEPTS

- Red blood cell transfusion is indicated only to increase oxygen delivery at the tissue level.
- One unit of PRBCs can be expected to raise an adult's hemoglobin level by 1 g/dL. A similar increase is expected in children following the transfusion of 10 mL/kg of PRBCs.
- Large randomized controlled trials have supported newer, restrictive, red cell transfusion strategies. Pending further trials, a transfusion trigger of 7 to 8 g/dL is appropriate for most stable hospitalized patients.
- Platelet transfusions are typically used prophylactically for counts less than 10,000/ $\mu$ L in patients without bleeding and for counts less than 50,000/ $\mu$ L for patients undergoing surgery. Patient's undergoing high-risk surgical procedures, such as neurosurgery, are often transfused for platelet counts less than 100,000/ $\mu$ L.
- Prospective and retrospective reports have suggested a benefit to massive transfusion protocols, and the results of the PROPPR trial comparing a 1:1:1 ratio of FFP to platelets to PRBCs to a 1:1:2 ratio showed no difference in mortality at 24 hours or 30 days, although a post hoc analysis did find fewer deaths by exsanguination in the first 24 hours with a 1:1:1 ratio.
- FFP is not recommended for volume expansion, nonurgent reversal of a vitamin K antagonist, or treatment for an abnormal INR from any cause in the absence of bleeding. PCC is recommended for these cases, and four-factor concentrates are preferred, if available.
- Intravascular hemolytic transfusion reaction is the most serious transfusion reaction. It is usually the result of ABO incompatibility and typically results in immediate symptoms that can include fever, chills, headache, nausea, vomiting, sensation of chest restriction, severe joint or low back pain, burning sensation at the site of the infusion, and feeling of impending doom.
- Transfusion-related acute lung injury is now the leading cause of transfusion-related mortality reported to the FDA.
- Improved techniques for selecting and testing blood donors have dramatically reduced the risk of viral transmission of disease by transfusion. It is believed that the blood supply in the United States has never been safer.

## CHAPTER 111: QUESTIONS &amp; ANSWERS

- 111.1. Which one of the following immune-mediated transfusion reactions is most common and least serious?
- Allergic reaction
  - Extravascular hemolysis
  - Febrile reaction
  - Intravascular hemolysis
  - Transfusion-related acute lung injury

**Answer: C.** Febrile transfusion reaction is the most common and least serious transfusion reaction. It is defined as a 1°C (33.8° F) or higher temperature elevation that occurs with transfusion and for which no other medical explanation is found. Reactions are believed to result from antileukocyte antibodies, usually as a result of prior transfusion. Treatment is symptomatic with analgesics, antipyretics, and antihistamines.

- 111.2. An 81-year-old woman with a history of congestive heart failure (CHF) requires transfusion. She suffers from chronic anemia and is currently normotensive but tachypneic because of her CHF. You want to minimize the risk of fluid overload by transfusing slowly. Over how many hours can the transfusion be given?
- 2
  - 3
  - 4
  - 6
  - 12

**Answer: C.** Chronically anemic, normovolemic older patients are at greatest risk for developing congestive heart failure with the rapid infusion of blood. Transfusing more slowly (over a period of 4 hours) and administering diuretics are useful in preventing this complication.

- 111.3. Which of the following transfusion reactions is usually the result of ABO incompatibility, usually caused by human error, and considered to be the most serious transfusion reaction?
- Extravascular hemolytic transfusion reaction
  - Febrile transfusion reaction
  - Intravascular hemolytic transfusion reaction
  - Transfusion-associated graft-versus-host disease
  - Transfusion-related acute lung injury

**Answer: C.** An intravascular hemolytic transfusion reaction is considered to be the most serious of the transfusion reactions. It is usually caused by ABO incompatibility and is most often secondary to human error.

- 111.4. A 15-year-old male is receiving transfusion of packed red blood cells after a traumatic injury when he complains of itching. On examination, hives are found, and soon the patient develops difficulty breathing, tachypnea, tachycardia, and hypotension. The transfusion is stopped. Which of the following medications should be administered?
- Acetaminophen
  - Epinephrine and corticosteroids
  - Furosemide
  - RhoGAM
  - Third-generation cephalosporin

**Answer: B.** Occasionally, full anaphylaxis may be caused by an anti-immunoglobulin A (IgA) reaction to IgA in the donor's blood components. The patient is likely to have a genetic IgA deficiency. The presentation is similar to anaphylactic reactions from other causes. Treatment is with epinephrine and corticosteroids. Washed red blood cells (RBCs) and plasma products from IgA-deficient individuals can be used to avoid recurrence with subsequent transfusions.

## KEY CONCEPTS

- Anemia is caused by three basic mechanisms: bleeding, destruction of RBCs, and decrease in production of RBCs.
- The use of RBC indices and a peripheral blood smear can help determine the mechanism of anemia.
- Anemia in the elderly often occurs as an exacerbation of preexisting comorbid diseases.
- Anemia of uncertain etiology should be thoroughly evaluated. If the patient has no adverse hemodynamic consequences, the evaluation can proceed on an outpatient basis or management initiated in an observation unit until the patient is stable and can be managed as an outpatient.
- Patients with sickle cell disease should be considered to have an acute pain crisis and treated appropriately until it is proved otherwise.
- Acute chest syndrome is one of the most common causes of death in sickle cell disease.
- Transfusion therapy is most useful in sickle cell disease associated with acute stroke (in children), acute chest syndrome, and splenic sequestration.
- Polycythemia is classified as apparent (eg, dehydration), primary (eg, myeloproliferative disorder), or secondary (eg, carcinoma or other conditions), and treatment is targeted at the cause.

## CHAPTER 112: QUESTIONS &amp; ANSWERS

**112.1.** Anemia with an elevated mean corpuscular volume (MCV) is *not* typically seen with which of the following conditions?

- A. Folate deficiency
- B. Hypothyroidism
- C. Iron deficiency
- D. Liver disease
- E. Vitamin B<sub>12</sub> deficiency

**Answer: C.** Iron deficiency anemia typically presents as a microcytic anemia. Liver disease may present with either a macrocytic anemia or a normocytic anemia reflecting an anemia caused by multiple mechanisms.

**112.2.** An elevated mean corpuscular hemoglobin concentration (MCHC) is expected in which of the following conditions?

- A. Anemia of chronic disease
- B. Iron-deficiency anemia
- C. Sideroblastic anemia
- D. Spherocytosis
- E. Vitamin B<sub>12</sub> deficiency

**Answer: D.** The MCHC index is a measure of the concentration of hemoglobin. Low values represent hypochromia, whereas high values are noted only in patients with decreased cell membrane area relative to volume, such as spherocytosis.

**112.3.** A 31-year-old woman presents with complaints of easy fatigability and heavy regular menses. She is not pregnant and is otherwise healthy. Complete blood count shows the following:

White blood cell (WBC) count: 7300 cells/mm<sup>3</sup>

Platelet count: 453,000 cells/mm<sup>3</sup>

Hemoglobin: 8.4 g/dL

Hematocrit: 25%

Mean corpuscular volume (MCV): 82 fL<sup>3</sup> (81–100 fL<sup>3</sup>)

Mean corpuscular hemoglobin concentration (MCHC): 29% (31% to 36%)

Physical examination is only remarkable for conjunctival pallor. Which of the following statements regarding this patient's condition is *true*?

- A. Hemoglobin rise from iron therapy begins in a week.
- B. Parenteral iron therapy is indicated.
- C. Reticulocytosis from iron therapy will be seen in 24 to 48 hours.
- D. The normal MCV should prompt an in-depth anemia evaluation.
- E. Transfusion is indicated.

**Answer: A.** Microcytic anemia, in cases of iron deficiency, occurs late because marrow and cytochrome iron sources must first be exhausted. The treatment for chronic iron-deficiency anemia is oral iron replacement, which in adults produces a reticulocytosis and hemoglobin rise in approximately 1 week. Parenteral iron therapy is almost never indicated. Transfusion is rarely required unless the blood loss is acute or comorbidities necessitate immediate improvement of blood oxygen-carrying capacity.

**112.4.** A 21-year-old man presents with easy fatigue and lack of energy. During a recent clinic visit, he was found to be anemic with a hemoglobin of 8 g/dL, mean corpuscular hemoglobin concentration (MCHC) of 25%, mean corpuscular volume (MCV) of 61 fL, and a peripheral smear remarkable for target cells and basophilic stippling. Serum iron levels were normal. What is the most likely explanation for his anemia?

- A. Iron deficiency
- B. Lead poisoning
- C. Porphyria
- D. Sideroblastic anemia
- E. Thalassemia

**Answer: E.** Hypochromic, microcytic anemias with normal serum iron imply thalassemia (a defect in globin chain production). Both alpha- and beta-thalassemia show a hypochromic microcytic picture with target cells and basophilic stippling. The microcytosis is generally more severe than with iron-deficiency anemia. Sideroblastic anemia generally presents with elevated serum iron.

**112.5.** A 73-year-old woman presents with progressive fatigue. Her only past medical history is rheumatoid arthritis for which she takes methotrexate. She has no cardiopulmonary history and does not smoke. Physical examination is remarkable only for bilateral metacarpophalangeal, chronic swelling, and mild splenomegaly. Recent blood tests from the clinic are remarkable for a high normal serum iron, hemoglobin of 10 g/dL, and mean corpuscular volume (MCV) of 69 fL, with peripheral smear showing both microcytes and macrocytes. Which of the following is the most appropriate intervention?

- A. A trial of pyridoxine
- B. Hematology consultation for bone marrow biopsy
- C. Hematology consultation for iron chelation
- D. Send blood for vitamin B<sub>12</sub> and folate levels
- E. Toxicology consultation for lead chelation



**Answer: A.** Sideroblastic anemia may be acquired or inherited. It is typically a refractory anemia in the elderly characterized by hypochromia and microcytosis but a dimorphic smear also showing normal cells and macrocytes. Some of these patients are pyridoxine deficient and may respond to a course of vitamin B<sub>6</sub>. This anemia is a defect in porphyrin synthesis and is associated with rheumatoid arthritis, cancer, and infections. Lead poisoning is a subset. Elevated iron and ferritin levels are seen because the porphyrin defect does not allow iron incorporation and cells hemolyze in the bone marrow.

**112.6.** Which of the following statements regarding anemia of chronic disease is *true*?

- A. A search for occult blood loss is indicated.
- B. Hematocrits frequently fall to the 20% to 24% range.
- C. Iron levels are always normal.
- D. Iron therapy is beneficial.
- E. It is a microcytic anemia.

**Answer: A.** Anemia of chronic disease (ACD) is a normocytic anemia most commonly associated with cancer, infection, and uremia. Hematocrit drops are generally modest, with levels seldom below 25% to 30%. An iron-deficiency anemia may often be superimposed, and a search for occult blood loss is indicated. It is characterized by low serum iron, low iron binding capacity, and increased ferritin. Bone marrow examination is often normal except for increased reticuloendothelial staining for iron, which cannot be mobilized. It is refractory to iron therapy.

- 112.7.** A 43-year-old woman presents with difficulty walking and complaints of depression that have progressively worsened over several weeks. She has no past medical history, takes no medications, and does not drink alcohol or smoke. Physical examination is remarkable for clinical depression, a spastic gait, decreased extremity proprioception, and lower extremity hyporeflexia. What test should be obtained next in this patient's evaluation?
- A. Complete blood count with differential diagnosis and RBC indices
  - B. Lumbar puncture
  - C. Magnetic resonance imaging (MRI) of the spine
  - D. Serum potassium and calcium levels
  - E. Serum thyroid-stimulating hormone (TSH)

**Answer: A.** Vitamin B<sub>12</sub> deficiency presents classically with very low hemoglobin levels, a macrocytic picture, decreased proprioception and/or vibration, lower extremity spasticity/weakness with hyporeflexia, and often mental status changes, such as depression, forgetfulness, or even paranoia. Irritability and forgetfulness are also seen with folate deficiency.

**112.8.** A 43-year-old man presents with fatigue and dyspnea on exertion. He has no significant past history. Physical examination is remarkable for pale conjunctivae. Vital signs are heart rate, 108 beats per minute; blood pressure, 115/70 mm Hg; respiratory rate, 18 breaths per minute; temperature, 37° C; and O<sub>2</sub> saturation, 96% on room air. Laboratory examination is remarkable for the following:

White blood cell (WBC) count: 3200 cells/mm<sup>3</sup>

Hemoglobin: 7 g/dL

Hematocrit: 21%

Platelet count: 71,000 cells/mm<sup>3</sup>

Reticulocyte count: 0.9%

Which of the following tests will most likely lead to the diagnosis?

- A. Drug/toxin exposure history
- B. Fecal hemoccult test
- C. Liver function tests
- D. Serum creatinine
- E. Urinalysis

**Answer: A.** Aplastic anemia typically presents as a normochromic, normocytic anemia with a low reticulocyte count. Most cases involve all cell lines. More than 50% of cases are due to drug or chemical exposures. See [Table 112.6](#).

**112.9.** Which of the following conditions is associated with macrocytic anemia?

- A. Adrenal insufficiency
- B. Hypothyroidism
- C. Pituitary insufficiency
- D. Renal failure
- E. Tuberculosis

**Answer: B.** Hypothyroidism may be associated with macrocytic or normocytic indices. The latter is the typical case in anemia of chronic disease (ACD). All of the other choices may be associated with ACD and typically normocytic (occasionally microcytic) indices and low erythropoietin levels.

## KEY CONCEPTS

- CLL is the most common leukemia in the elderly, and ALL is the most common leukemia in children.
- Splenomegaly is a common finding in leukemias.
- Leukostasis is usually not accompanied by clinical sequelae until the WBC is more than 500,000.
- Neutropenia plus a fever should be treated as a life-threatening infection until proven otherwise.
- Postinfection is the most common cause of neutropenia in children.
- WBC determination in the emergency department has poor sensitivity and specificity for any specific disease process.
- Inflammatory markers, absolute neutrophil count and bandemia may be more useful for identifying infection than the absolute WBC.

## CHAPTER 113: QUESTIONS &amp; ANSWERS

- 113.1.** A febrile patient who has abdominal pain arrives to the emergency department (ED). The surgery consultant demands to know the value of the white blood cell (WBC) count, “because it will help determine whether the patient has a bacterial infection in the abdomen.” Which of the following statements best describes the use of WBC in the care of emergency patients?
- May be useful in selecting patients for observation
  - The absolute neutrophil count and a bandemia may be more helpful than the total WBC count in identifying bacterial infection
  - The WBC is nonspecific and nonsensitive and has little screening value in the ED
  - All of the above

**Answer: D.** All of the above statements are true. The WBC count and accompanying differential count are the most common laboratory tests ordered in the ED. Unfortunately, the WBC count has not proved to be a highly sensitive or specific test, and the absence of leukocytosis does not exclude the presence of significant disease. In evaluation of the bacterial infectious potential in febrile children, the WBC and differential counts have demonstrated limited usefulness. Other biomarkers, such as procalcitonin and C-reactive protein (CRP), may have more predictive value. Thus, the WBC test should be viewed as having limited screening value in the acute care setting because multiple agents and conditions can increase the WBC count. Although the WBC count may be nonspecific and nonsensitive, studies evaluating the WBC count for the diagnosis of abdominal pain have found it to be a useful in selecting patients for observation, and the differential count may provide helpful information. The absolute neutrophil count and a high band count may be more helpful than the total WBC count in identifying bacterial infection.

- 113.2.** Which of the following can affect the “normal” white blood cell (WBC) count?
- Age and race
  - Exercise
  - Gender
  - Smoking
  - All of the above

**Answer: E.** All of the above statements are true. One unique problem in WBC disorders is the wide variability in normal values and the multiple factors influencing them. Normal values for the WBC count are listed in Table 113.1. The “normal” count is age dependent and may be shifted upward by exercise, gender (women), smoking, and pregnancy. Decreases in the total WBC count range by 1000 to 1200 cells/mm<sup>3</sup> have been noted in the African American population.

- 113.3.** In evaluating a patient with severe neutropenia, which of the following is false?
- If the patient also has a fever, basic isolation techniques and specific therapies should be initiated after cultures are completed.
  - If the patient also has a fever, urine and blood cultures should be obtained.
  - The clinician should ask about their medication list, a history of neutropenia, a family history, and a review of recent infections.
  - The physical signs of infection should be obvious because of the inflammatory response.
  - The review of systems focuses on bleeding problems, fatigue, sweats, weight loss, and autoimmune symptoms.

**Answer: D.** The physical signs of infection may be minimal in severe neutropenia because there are too few cells to generate a substantial inflammatory or purulent response.

- 113.4.** A patient with a known history of chronic myeloid leukemia (CML) presents with shortness of breath. His white blood cell (WBC) count is 25,000 cells/mm<sup>3</sup>. The etiology of his shortness of breath is least likely to be due to which of the following?
- Angina
  - Heart failure
  - Hyperleukocytosis resulting in pulmonary ventilation-perfusion abnormalities
  - Renal failure and fluid overload
  - Severe anemia

**Answer: C.** Hyperleukocytosis occurs, but the more mature, “less sticky” cells in CML do not usually cause problems unless the count exceeds 500,000 cells/mm<sup>3</sup>. A higher cell count may cause leukostasis and result in deafness, visual impairment, pulmonary ventilation-perfusion abnormalities, and priapism. Treatment involves hydration, leukapheresis, transfusion as necessary, allopurinol to prevent severe hyperuricemia, and specific chemotherapy. The need for urgent therapy in CML is usually related to hyperuricemia and renal injury or severe anemia and subsequent angina or heart failure.

- 113.5.** When applied to lymphocytic neoplasms, the terms *acute* and *chronic* describe all of the following except:
- Aggressiveness of therapy
  - Cell maturity
  - Patient survival time
  - Rapidity of onset

**Answer: C.** In the past, before therapy was available, *acute* and *chronic* were descriptive terms applied to lymphocytic neoplasms with respect to patient survival time. The terms *acute* and *chronic* are currently used to describe the cell maturity, rapidity of onset, and aggressiveness of therapy. Chronic lymphocytic leukemia (CLL) is primarily a B-cell disorder and is the most common type of leukemia in the population 50 years or older. Acute lymphocytic leukemia (ALL) is most commonly diagnosed in children younger than 10 years. It is the most frequent malignant neoplasm in children younger than 15 years of age.

## KEY CONCEPTS

- Although hemostatic disorders are confirmed by specific patterns of laboratory test results, a careful history and focused physical examination are often the key to the diagnosis of hematologic diseases.
- All patients with bleeding disorders of unknown cause or of a significant degree should be admitted to the hospital for further evaluation.
- The frequency of hemostatic disorders seen in the ED is unknown; however, they are likely to be more common than thought. Although classic diseases such as hemophilia and DIC are uncommon, the use of antiplatelet and anticoagulation agents is common in other disease states, such as cardiovascular diseases.
- Hemophilia patients are often highly informed about their disease. Patient input should be solicited and respected, and early consultation with the patient's hematologist is encouraged. Consider early treatment with replacement factor while diagnostic testing proceeds.
- Patients with active life-threatening bleeding who are thought to have a congenital bleeding disorder can be supported with fresh frozen plasma, 15 mL/kg, while diagnostic studies are being performed.
- Platelet dysfunction is often equated with low platelet counts. Even though critical thrombocytopenia increases the risk of bleeding, particularly with trauma and surgery, dysfunction can occur at normal counts. For example, aspirin therapy and renal disease can alter platelet function without reducing blood counts.
- All evaluations of suggested ITP should include a complete blood count, peripheral smear, antinuclear antibody test, and bone marrow examination.
- TTP should be suspected in the setting of thrombocytopenia and microangiopathic hemolytic anemia and early treatment with plasma exchange therapy should be initiated even in the absence of the classic pentad. Platelet replacement should be avoided.

## CHAPTER 114: QUESTIONS &amp; ANSWERS

**114.1.** Platelet counts below what level may be associated with severe spontaneous hemorrhage?

- A. 100,000  $\text{mm}^3$
- B. 50,000  $\text{mm}^3$
- C. 20,000  $\text{mm}^3$
- D. 10,000  $\text{mm}^3$
- E. 5000  $\text{mm}^3$

**Answer: C.** Remember that the count provides no information about the adequacy of platelet function.

**114.2.** An elevated partial thromboplastin time (PTT) may be caused by an abnormality or deficiency in which of the following?

- A. Calcium
- B. Factor VII
- C. Factor XIII
- D. Fibrinogen
- E. Platelets

**Answer: D.** The PTT tests the components of the intrinsic and common pathways—essentially all factors except VII and XIII. Fibrinogen function is reflected in both prothrombin time (PT) and PTT values. Calcium derangements do not typically cause aberrations in PT or PTT.

**114.3.** Which of the following statements regarding bleeding resulting from a platelet disorder is true?

- A. Males are affected more than females.
- B. Most platelet disorders are inherited.
- C. Preceding trauma does not usually cause the bleeding incident.
- D. Prothrombin time (PT) and partial thromboplastin time (PTT) may both be elevated.
- E. The bleeding often presents as hemarthrosis or muscle hematoma.

**Answer: C.** Platelet abnormalities are seen most commonly in females and are acquired, often because of drugs, infections, or triggered immunologic mechanisms. The bleeding is typically capillary and does not involve joints or deep muscle. Most of the bleeding is spontaneous.

**114.4.** A 48-year-old man presents with complaints of leg pain and swelling. Physical examination is remarkable for right lower extremity pallor, mild edema, and absent distal pulses. Laboratory examination is remarkable only for a platelet count of 21,000/ $\text{mm}^3$ . Which of the following statements is true?

- A. A history of a recent blood transfusion is likely.
- B. A history of intravenous cocaine use is likely.
- C. A recent viral illness is likely.
- D. Recent digoxin use is likely.
- E. Recent heparin use is likely.

**Answer: E.** Heparin-induced thrombocytopenia (HIT) is characterized by post heparin thrombocytopenia (onset 7 to 40 days) and arterial or venous thrombosis. Intravenous cocaine, digoxin use, sulfonamide use, phenytoin use, recent blood transfusion (PLAI antigen mediated—usually a precipitous drop in platelets 1 week post-transfusion) are all associated with thrombocytopenia but not thrombosis. Treatment of HIT is with direct thrombin (lepirudin) or factor Xa (fondaparinux) inhibitors.

**114.5.** A 4-year-old boy is brought to the emergency department (ED) by his parents, who report several days of easy bruising on his lower extremities with even minor trauma. He has no past medical history and takes no medications. Physical examination is remarkable for a well-appearing child with lower extremity ecchymoses with some petechiae. You do not suspect child abuse. Laboratory evaluation reveals the following: white blood count (WBC) count, 9300/ $\text{mm}^3$ ; hemoglobin (Hb), 12.6 g/dL; hematocrit (Hct), 37%; and platelet count (Plt), 21,000/ $\text{mm}^3$ . Which of the following statements regarding this scenario is true?

- A. A history of antecedent viral illness is likely.
- B. Coagulation factor levels are probably low.
- C. Corticosteroids are indicated.
- D. Platelet transfusion is indicated.
- E. The adult form of this entity is of shorter duration.

**Answer: A.** Idiopathic thrombocytopenia purpura is an autoimmune process. In children, it typically follows an antecedent viral illness and remits spontaneously in 90% of cases. Steroids are not helpful. Platelet transfusion is rarely, if ever, required. Coagulation factors are not affected. The adult form is more insidious, chronic, and more likely to be associated with systemic disease, such as lupus or lymphoma.

## KEY CONCEPTS

- SVC syndrome occurs due to either external (eg, tumor) or internal (eg, thrombus) obstruction of the SVC.
- ED management of SVC syndrome is largely supportive. The head of the bed should be elevated and supplemental oxygen provided if needed. If the cause of SVC syndrome is determined to be thrombus, anticoagulation may be initiated if not contraindicated.
- SVC syndrome is life threatening in the rare case of cerebral edema, hemodynamic collapse, or tracheal compromise. Definitive anti-cancer treatment should be postponed to allow for tissue diagnosis of the underlying mass if not already known.

## CHAPTER 115: QUESTIONS &amp; ANSWERS

- 115.1. Which of the following statements regarding infections in cancer patients with febrile neutropenia is *true*?
- Blood cultures should be obtained from an indwelling catheter if present.
  - Head computed tomography (CT) is always indicated.
  - Lumbar puncture (LP) should be routinely undertaken.
  - Most isolated pathogens are gram negative.
  - Sinus imagery should be routinely undertaken.

**Answer: A.** In patients with a preexisting central line, one of the blood cultures should be obtained peripherally while other cultures should be simultaneously drawn off each lumen of the central catheter. Bacterial growth in the catheter-drawn samples more than 2 hours prior to the peripheral samples is suggestive of a catheter-associated infection. Head CT is not routinely indicated. It may be performed if the patient demonstrates focal neurological deficits, alteration in mental status, or a lumbar puncture is planned. LP and CT scan of the sinuses are not routinely done unless signs or symptoms suggest these are involved.

- 115.2. A 33-year-old woman with breast cancer presents with fever and neutropenia. She is status post mastectomy and undergoing chemotherapy. Vital signs are remarkable for temperature, 38.8° C; heart rate, 110 beats/min; and blood pressure, 89/50 mm Hg. Examination is otherwise normal. She has no indwelling catheters. Which of the following is the most appropriate empirical antibiotic regimen?
- Antibiotics should be withheld pending radiographs and cultures
  - Cefepime as monotherapy
  - Ceftazidime and gentamicin
  - Meropenem and vancomycin
  - Ticarcillin and amikacin

**Answer: B.** Monotherapy with imipenem, meropenem, ceftazidime, or cefepime is as effective as traditional dual therapy with an antipseudomonal penicillin and aminoglycoside. However, vancomycin should be included as well if any of the following exist:

- Hypotension or evidence of cardiovascular impairment
- Clinically suspected catheter infection
- Positive blood cultures for gram-positive organisms
- Known colonization with methicillin-resistant *Staphylococcus aureus* or cephalosporin-resistant *Pneumococcus*

- 115.3. A 57-year-old man presents with exertional dyspnea, facial swelling, cough, and bilateral hand swelling. His past medical history is unremarkable except for many years of heavy smoking. Physical examination is remarkable for moderate conjunctival suffusion, jugular venous distention (JVD), upper extremity venous prominence, and facial plethora. Which of the following statements regarding this patient's likely condition is *true*?
- Corticosteroids are indicated urgently.
  - Intravenous furosemide should be initiated emergently.

- Treatment depends upon the tissue diagnosis.
- Urgent radiotherapy is indicated.
- Venography is the initial test of choice.

**Answer: C.** Superior vena cava (SVC) syndrome is most commonly caused by lung cancer, although non-oncologic etiologies (thrombosis from indwelling catheter) are increasing. Unless the patient is in acute respiratory distress, emergent interventions are not indicated and intervention should follow tissue diagnosis. The main "rule outs" are congestive heart failure and pericardial tamponade. Diuretics may provide symptomatic relief but are not emergently indicated. Corticosteroids are not useful unless there is airway compromise.

- 115.4. Which of the following is *not* a risk factor for acute tumor lysis syndrome (TLS)?
- High-burden, rapidly growing and highly chemosensitive leukemias.
  - Hypovolemia
  - Old age
  - Preexisting renal dysfunction
  - Rapidly growing solid tumors

**Answer: C.** TLS is most likely to occur in patients with tumors that are high-burden, rapidly growing, and highly chemosensitive, such as Burkitt's lymphoma or acute lymphoblastic leukemia (ALL). TLS occurs less commonly in rapidly growing solid tumors, such as breast, testicular, and small cell lung cancers; overall the diversity of malignancies with potential for TLS is growing as we develop more effective and fast-acting chemotherapeutics. Patient factors predisposing to TLS include preexisting renal failure, hypovolemia, and hyperuricemia. Old age is not a known risk factor for TLS.

- 115.5. A 65-year-old male with a history of a large head and neck tumor presents with symptoms of fatigue, weakness, confusion, depression and malaise, nausea, vomiting, constipation, polyuria, and palpitations. His electrocardiogram (ECG) demonstrates a shortened QT interval. Which of the following electrolyte abnormalities is likely to underlie his presentation?
- Hypercalcemia
  - Hyperkalemia
  - Hyperuricemia
  - Hypocalcemia
  - Hypokalemia

**Answer: A.** Approximately 30% of cancer patients will experience dysregulation of calcium homeostasis. malignancy-associated hypercalcemia (MAH) signifies advanced disease, with median survival of less than 2 months. Synthesis of PTHrP, classically called *humoral hypercalcemia*, causes about 80% of cases of MAH, and is usually associated with squamous cancers, such as lung, esophagus, head and neck, cervical, ovarian, and endometrial carcinomas. Presenting symptoms often include weakness, lethargy, confusion, abdominal pain, nausea, vomiting, constipation, polyuria, polydipsia, and kidney injury. Electrocardiogram findings may initially exhibit QT interval shortening, progressing to dysrhythmias and heart block as hypercalcemia worsens.



## KEY CONCEPTS

- Patients with an acute severe metabolic acidosis rely on a robust respiratory compensation; in these cases, the adequacy of the ventilatory response should be assessed and augmented, with noninvasive or invasive ventilation, if needed.
- The strong ion difference =  $([Na^+ + K^+] - [Cl^-])$ . When significantly less than 40, an acidosis is present.
- The delta gap ( $\Delta G$ ) =  $(AG - 12) - (24 - [HCO_3^-])$ . Its calculation determines if the anion gap is accounted for by the change in serum bicarbonate concentration. An elevated anion gap and  $\Delta G$  more than 6 indicates that a metabolic alkalosis in addition to a metabolic acidosis is likely to be present.
- Patients who have a chronic respiratory acidosis (eg, in chronic obstructive pulmonary disease) are at risk for dangerous alkalemia if they are ventilated with routine parameters. Blood gas analysis in these cases should be performed frequently and settings titrated to the serum pH.
- Alcoholic ketoacidosis may be manifested similarly to diabetic ketoacidosis but is much less common; insulin is contraindicated in alcoholic ketoacidosis.
- When an elevated anion gap is recognized, the initial assessment focuses on identifying one of four causes: ketoacidosis, toxic ingestions, lactic acidosis, and renal failure. Typically, only chronic renal failure causes significant acidosis.
- Anion gap =  $Na^+ - (Cl^- + HCO_3^-)$ . Causes of an elevated anion gap include ketoacidosis, lactic acidosis, toxins metabolized to acids, and renal failure.
- When the cause of an elevated anion gap is determined to be lactate or ketones, diagnostic efforts are directed at identifying the cause of the lactic acidosis or ketoacidosis.
- Sodium bicarbonate is not recommended for the empirical treatment of acidemia; it is an option in cases of severely depressed pH thought to pose an immediate life threat.

## CHAPTER 116: QUESTIONS &amp; ANSWERS

**116.1.** A 31-year-old man has the following laboratory values:

Sodium = 142 mEq/L

Potassium = 3.8 mEq/L

Chloride = 110 mEq/L

Bicarbonate = 29 mEq/L

Creatinine = 1.0 mg/dL

Which of the following is true?

- A. He may have a low albumin level.
- B. Ionized calcium will be low.
- C. Organic alcohol ingestion should be considered.
- D. The blood glucose level is likely elevated.
- E. The serum lactate level will be elevated.

**Answer: A.** This patient has an anion gap of 3. Because the anion gap is due to unmeasured anions such as albumin, sulfate, phosphate, and citrate, isolated depressions of these may cause a low anion gap. Hypoalbuminemia would be such a case.

**116.2.** What is the most common cause of normal anion gap metabolic acidosis?

- A. Acetazolamide use
- B. Diarrhea
- C. Hypoaldosteronism
- D. Magnesium sulfate
- E. Renal tubular acidosis

**Answer: B.** Chronic diarrhea is the most common cause.

**116.3.** A 61-year-old man presents with nausea, vomiting, and lethargy. He was found in his apartment by neighbors, who called emergency medical services. There were no signs of trauma and no medications discovered. There were several empty liquor bottles but no smell of intoxication. Examination reveals a thin unkempt male who is lethargic but grossly neurologically intact. Vital signs are temperature 35°C (95°F), heart rate (HR) 120 beats/min, blood pressure 105/60 mm Hg, respiratory rate (RR) 28 breaths/min, and O<sub>2</sub> saturation 96%. Laboratory evaluation reveals the following:  
Po<sub>2</sub> = 88 mm Hg  
Pco<sub>2</sub> = 30 mm Hg  
pH = 7.47

Sodium = 138 mEq/L

Potassium = 3 mEq/L

Chloride = 90 mEq/L

HCO<sub>3</sub> = 30 mEq/L

Glucose = 140 mg/dL

Urinalysis = specific gravity (SG) 1.024 and trace ketones

Which of the following is true?

- A. A chest CT is indicated.
- B. Crystalloid alone will correct the abnormalities.
- C. His urinary ketone levels will increase with treatment.
- D. Insulin infusion is indicated.
- E. The pH is appropriate for the HCO<sub>3</sub> and Pco<sub>2</sub> levels.

**Answer: C.** Alcoholic ketoacidosis (AKA) usually presents after abrupt alcohol intake cessation following a binge. Ketoacidosis, malnutrition, and dehydration all coexist. Urine ketone levels may be minimal due to the lack of detection of  $\alpha$ -hydroxybutyrate, prominent in AKA. This is later converted to acetoacetate and acetone, transiently worsening the ketosis while improving the ketoacidosis during treatment. Measurement of urine ketone levels can therefore produce paradoxical results. Dextrose-containing fluids are the mainstay of treatment; insulin is contraindicated. This patient has a complex acid-base disorder with a combination of an anion gap acidosis caused by AKA, with secondary respiratory alkalosis and primary metabolic alkalosis from vomiting.

**116.4.** How does isoniazid (INH) cause a metabolic acidosis?

- A. INH acts as a cellular toxin by uncoupling oxidative phosphorylation.
- B. INH causes bicarbonate wasting at the level of the glomerulus.
- C. INH causes increased lactic acid production by liver toxicity.
- D. INH is acidic and lowers serum pH directly.
- E. INH overdose causes seizures, which lead to a metabolic acidosis.

**Answer: E.** Isoniazid overdose is an important cause of seizures, especially seizures that are unresponsive to conventional therapies. Treatment of INH-induced seizures is vitamin B<sub>6</sub> (pyridoxine).



- 116.5.** A 26-year-old G3P2 woman at 32 weeks of gestation presents with mild dyspnea on exertion for several weeks. She has no pain and no other complaints. Physical examination is remarkable only for a RR of 26 breaths per minute. Arterial blood gas reveals the following:  
 $\text{Po}_2 = 98 \text{ mm Hg}$   
 $\text{Pco}_2 = 32 \text{ mm Hg}$   
 $\text{pH} = 7.49$   
 $\text{HCO}_3^- = 19 \text{ mEq/L}$   
The complete blood count, electrocardiogram, and chest radiograph with shielding are normal. Which of the following is true?
- A. No intervention is indicated.
  - B. Salicylate levels are indicated.
  - C. Serum lactate level will be helpful.
  - D. There is an underlying metabolic acidosis.
  - E. Ventilation-perfusion scan is indicated.

**Answer: A.** Alkalemia of pregnancy occurs early and is sustained throughout gestation. A  $\text{Pco}_2$  of 31 to 35 mm Hg with a compensatory drop in serum  $\text{HCO}_3^-$  is normal. The pH ranges from 7.46 to 7.50. All these values are normal for pregnancy.

- 116.6.** A patient with severe, long-standing chronic obstructive pulmonary disease presents in respiratory distress and requires endotracheal intubation. Blood gas analysis 20 minutes later shows the following:  
 $\text{pH} = 7.55$   
 $\text{Po}_2 = 140 \text{ mm Hg}$   
 $\text{Pco}_2 = 37 \text{ mm Hg}$   
 $\text{HCO}_3^- = 44 \text{ mEq/L}$   
What is the likely explanation for these results?
- A. The patient has a chronically elevated serum bicarbonate level.
  - B. The patient has coexisting hypoalbuminemia.
  - C. The patient is receiving too much supplemental oxygen.
  - D. The patient received supplemental bicarbonate therapy.

**Answer: A.** Patients with long-standing respiratory acidosis develop a compensatory metabolic alkalosis with an elevated serum bicarbonate level. When these patients are mechanically intubated, minute ventilation should be reduced compared with normal patients and should be titrated to pH.

- 116.7.** An older patient presents with altered mental status without a clear cause after a history and

physical examination. Blood gas analysis shows the following:

$\text{pH} = 7.44$

$\text{Po}_2 = 94 \text{ mm Hg}$

$\text{Pco}_2 = 19 \text{ mm Hg}$

$\text{HCO}_3^- = 21 \text{ mEq/L}$

These results should prompt consideration of which cause of altered mental status?

- A. Acute coronary syndrome
- B. Intracranial hemorrhage
- C. Salicylate toxicity
- D. Urosepsis

**Answer: C.** Chronic salicylate toxicity is an important concern in older patients, and an unexplained respiratory alkalosis may be the most important presenting finding. A history targeting long-standing salicylate use and measurement of the serum salicylate level are appropriate next steps.

- 116.8.** A patient presents with diabetic ketoacidosis. The initial blood gas shows a serum pH of 7.05. Resuscitation with normal saline can cause which acid-base disturbance?
- A. Metabolic acidosis
  - B. Metabolic alkalosis
  - C. Respiratory acidosis
  - D. Respiratory alkalosis

**Answer: A.** Because normal saline is acidic compared with serum, use can cause a non-anion gap hyperchloremic metabolic acidosis. Although this type of acidosis is generally well tolerated, if the serum pH is severely depressed, switching to a more balanced electrolyte solution may be prudent.

- 116.9.** In which case should sodium bicarbonate be used?
- A. A patient in cardiac arrest of uncertain cause
  - B. A patient pulled from a fire thought to be exposed to cyanide
  - C. A patient with heterocyclic antidepressant overdose
  - D. A patient with sepsis, lactic acidosis, and serum pH of 6.9

**Answer: C.** Sodium bicarbonate as an empirical treatment for acidemia or undifferentiated cardiac arrest is not recommended; however, sodium bicarbonate should be administered when indicated as a specific therapy, such as in certain toxic ingestions.

## KEY CONCEPTS

- Asymptomatic electrolyte abnormalities can usually be corrected slowly, but those that cause profound mental status changes or life-threatening arrhythmias require immediate correction to avoid cardiac arrest or seizures.
- IV calcium should be used only for hyperkalemic emergencies, defined as the following: widening QRS; sine wave; cardiac arrest believed to be due to hyperkalemia; or rapidly evolving electrocardiographic changes, from normal to development of tall peaked T waves and loss of the P wave. Acute, rapid rises in serum potassium concentration are rare but may be seen in tumor lysis syndrome, rhabdomyolysis, or massive hemolysis.
- After the critical decision about administration of calcium has been made, a  $\beta_2$ -agonist, insulin and glucose, normal saline, and bicarbonate (if the patient is acidotic) can be given to shift potassium intracellularly.
- In treatment of hypokalemia, the physician should also replace magnesium sulfate, in addition to potassium, or the patient will excrete most of the infused potassium in the urine.
- Low serum potassium levels reflect a much greater total potassium deficit; correction of large deficits can require several days.
- Hypertonic saline should be reserved for severely hyponatremic patients (typically in the 100 to 110 mEq range) who present with coma, seizures, or focal neurologic deficits. Central pontine myelinolysis can occur if serum sodium concentration is raised rapidly by more than 10 to 12 mEq/day.

## CHAPTER 117: QUESTIONS &amp; ANSWERS

**117.1.** A patient with end-stage renal disease misses dialysis and presents feeling weak. His 12-lead electrocardiogram (ECG) shows peaked T waves, absent P waves, and a QRS duration of 240 milliseconds. Which of the following is the next step in emergency department (ED) management?

- A. Calcium chloride
- B. Furosemide
- C. Hemodialysis
- D. Insulin with glucose
- E. Nebulized albuterol

**Answer: A.** Calcium chloride is the first medication that should be administered in this patient with a widened QRS. The treatment of hyperkalemia is based on the clinical scenario combined with the 12-lead ECG and the laboratory potassium value. Evaluating the ECG of patients at risk for this electrolyte disturbance is critical because results of the serum potassium level can be delayed. Hyperkalemia can be rapidly progressive, and lifesaving interventions should be instituted at the earliest suspicion of toxicity. Intravenous (IV) calcium is used to stabilize the cardiac membrane by restoring the electrical gradient. Calcium increases the depolarization threshold and the calcium gradient across the cardiac membrane, quieting myocyte excitability and increasing cardiac conduction speed, thus narrowing the QRS.

**117.2.** A young pregnant woman with eclampsia is transferred to the emergency department (ED) on a magnesium sulfate drip. She is barely arousable and has slow respirations. On examination, she has diffuse crackles in her lungs and absent reflexes. After oxygen is provided and she is attached to a monitor, what is the best treatment?

- A. Activated charcoal
- B. Calcium gluconate
- C. Glucagon
- D. Naloxone
- E. Sodium bicarbonate

**Answer: B.** Calcium gluconate is the medication of choice in patients with suspected hypermagnesemia. Patients with hypermagnesemia may present with flushing, nausea, vomiting, head ache, and diminished deep tendon reflexes. Intravenous (IV) calcium therapy to reverse magnesium toxicity should be reserved for patients with life-threatening symptoms while dialysis is being arranged. Calcium directly antagonizes the neuromuscular and cardiovascular effects of magnesium and is recommended in hypotensive patients with respiratory depression and cardiac instability.

**117.3.** For which of the following patients would it be most appropriate to supplement potassium to keep serum levels above 4 mEq/L?

- A. A 23-year-old woman with palpitations and no past medical history
- B. A 42-year-old woman with poorly controlled diabetes mellitus
- C. A 51-year-old man with hypertension, recently started on lisinopril
- D. A 55-year-old man with history of coronary artery disease, chest pain, and premature ventricular complexes
- E. A 68-year-old-man with chronic bronchitis and fever

**Answer: D.** The 55-year-old patient is at highest risk for life-threatening complications from hypokalemia secondary to his underlying comorbidities. In patients with cardiac ischemia or heart failure, even mild to moderate hypokalemia increases the likelihood of cardiac arrhythmias secondary to potassium's effect on the action potential.

**117.4.** A malnourished man with a long history of chronic obstructive pulmonary disease is brought to the emergency department (ED) in respiratory distress. He receives bronchodilators, intravenous (IV) dextrose, and thiamine. He improves significantly, but then begins to complain of severe muscle aches, diffuse weakness, and the feeling that he cannot breathe deeply.

Supplementation with which of the following might have prevented his new symptoms?

- A. Calcium gluconate
- B. Diazepam
- C. Normal saline
- D. Potassium phosphate
- E. Sodium bicarbonate

**Answer: D.** Patients with hypophosphatemia may present with nonspecific complaints, including joint pain, myalgias, irritability, and depression. Severe hypophosphatemia can be manifested as seizures, arrhythmias, cardiomyopathy, insulin resistance, acute tubular necrosis, rhabdomyolysis, and acute respiratory failure. Because hypophosphatemia often presents with hypokalemia, phosphate repletion should be considered in conjunction with potassium administration.

**117.5.** A patient in diabetic ketoacidosis (DKA) receiving insulin and intravenous (IV) fluids develops diffuse muscle weakness and pain. Her cardiac monitor shows broad T waves, U waves, and frequent premature ventricular complexes. What therapy is indicated?

- A. Calcium gluconate
- B. Dextrose
- C. Potassium chloride
- D. Sodium bicarbonate
- E. Sodium phosphate

**Answer: C.** Hypokalemia can be a dangerous complication during treatment of DKA, and potassium chloride should be administered to this patient demonstrating both clinical and diagnostic signs of hypokalemia. Administration of insulin may cause a reduction in serum potassium because of insulin's ability to stimulate the sodium-potassium adenosine triphosphatase ( $\text{Na}^+$ ,  $\text{K}^+$ -ATPase) pump and move potassium intracellularly. If there is any suspicion for hypokalemia or a patient presents with generalized weakness, palpitations, or arrhythmias, an electrocardiogram (ECG) should be obtained. A flattened broad T wave can be seen in hypokalemia. U waves, which are small deflections after the T wave, may also be seen. Patients should have their potassium repleted to prevent further complications.

**117.6.** A 58-year-old man with history of small cell lung cancer is brought in for weakness and pleuritic chest pain. He is alert, with normal vital signs, nonfocal neurologic examination, and serum sodium concentration of 129 mEq/L. What is the most appropriate management of the hyponatremia?

- A. Free water restriction
- B. Hypertonic saline bolus
- C. Intravenous (IV) furosemide
- D. Normal saline bolus
- E. Sodium chloride tablets

**Answer: A.** The patient with small cell lung cancer is demonstrating signs and symptoms of hyponatremia. Lung cancers, especially small cell cancer, can lead to the syndrome of inappropriate secretion of antidiuretic hormone (SIADH). The mainstay for treatment of euvolemic hyponatremia is free water restriction. As the hypo-osmolality in SIADH results from a relative abundance of water in the intracellular and extracellular volumes and is maintained by a reduced ability to excrete water, the restriction of free oral water intake is usually the most effective therapy. For relatively asymptomatic patients with sodium values of 115 to 135 mEq/L, a trial of free water restriction to less than 0.8 mL/day to 1.25 L/day should be attempted.

**117.7.** A runner is brought in after collapsing during a race. He has been careful to drink at each mile marker. He has altered mental status and is combative even after 10 mg of diazepam. What is the most appropriate treatment after his witnessed tonic-clonic seizure?

- A. 5% Dextrose solution
- B. Fosphenytoin
- C. Hypertonic saline
- D. Lorazepam
- E. Pentobarbital

**Answer: C.** This runner is demonstrating symptoms concerning for exercise-associated hyponatremia, the occurrence of hyponatremia during or up to 24 hours after prolonged physical activity. Hypertonic saline is indicated in severe cases of hyponatremia when a patient has alterations in mental status, focal neurologic findings, or seizures.

## KEY CONCEPTS

- The diagnosis of diabetes can be determined by one or more of four methods—random plasma glucose level above 200 mg/dL, fasting plasma glucose concentration above 126 mg/dL, 2-hour, 75-g postload OGTT > 200 mg/dL, or HbA<sub>1c</sub> value above 6.5%.
- DKA is diagnosed by the presence of hyperglycemia, anion gap metabolic acidosis, and elevated ketoacid levels.
- The essential treatment of DKA includes restoration of insulin, correction of dehydration, correction of potassium level, correction of acidosis, and treatment of the underlying cause.
- Use of sodium bicarbonate to correct acidosis in DKA has not demonstrated any benefit and may be associated with worse outcomes.
- A hyperglycemic hyperosmolar state is usually seen in older adults with multiple comorbid conditions and is distinguished from DKA by the absence of ketoacidosis. In addition to fluid resuscitation and correction of hyperglycemia, treatment should address the underlying cause of the state, which includes infection, myocardial infarction, and cerebrovascular accident.
- Diabetic peripheral neuropathy is common and has multiple treatment modalities, including gabapentin, pregabalin, and duloxetine.
- Diabetic foot ulcers and other diabetic soft tissue infections (eg, gas gangrene, Fournier's gangrene) are frequently polymicrobial and require broad-spectrum antibiotic therapy covering gram-positives, gram-negatives, and anaerobes.
- Hypoglycemia may be associated with significant morbidity and mortality. When the diagnosis is suggested and, if possible, confirmed by laboratory evaluation, therapy should be initiated immediately.
- Hypoglycemia caused by sulfonylurea oral hypoglycemic agents may be prolonged. Patients should be observed for an extended period or hospitalized.

## CHAPTER 118: QUESTIONS &amp; ANSWERS

- 118.1.** Which of the following statements regarding patients with impaired glucose tolerance is true?
- A. Spontaneous reversion to normal glucose tolerance is rare.
  - B. The condition is associated with fewer complications than diabetes mellitus.
  - C. The rate of decompensation to diabetes mellitus is greater than 10%/year.
  - D. There is a predisposition to ketosis.
  - E. There is no increased risk of cardiovascular complications.

**Answer: B.** Patients with impaired glucose tolerance have a glucose level between normal and diabetic. They are at increased risk of cardiovascular disease and development of diabetes (1%–5%/year), but it is not associated with the same degree of complications as with true diabetes. Many patients spontaneously develop normal glucose levels.

- 118.2.** What percentage of adults with type 2 diabetes are obese?
- A. 20%
  - B. 40%
  - C. 60%
  - D. 80%
  - E. 100%

**Answer: D.** Nonobese patients form a subgroup with a different disease, more similar to type 1 diabetes. Young people with maturity-onset diabetes often have an autosomal dominant inheritance, are nonobese, and have a relatively mild disease course.

- 118.3.** A 56-year-old man with a 10-year history of type 2 diabetes and poor glucose control (HbA<sub>1c</sub> = 10.7%) complains of constant burning pain in both feet. Which agent would be most appropriate to start in this patient for initial management of his symptoms?
- A. Aspirin, 325 mg PO daily
  - B. Carbamazepine, 200 mg tid
  - C. Naproxen, 500 mg bid
  - D. Oxycodone/acetaminophen, 5/325 mg qid
  - E. Pregabalin, 600 mg daily

**Answer: E.** Pregabalin in a dose of 600 mg daily gives pain relief in approximately 50% of patients with diabetic neuropathy. Duloxetine, 60 mg daily, achieves similar results. Gabapentin,

300 mg once a day up to tid, and amitriptyline, 25 mg daily, provide pain relief in approximately 33% of patients.

- 118.4.** A 27-year-old juvenile-onset diabetic is brought by emergency medical services (EMS) for a hypoglycemic coma. Fingerstick glucose level is 30 mg/dL. The paramedics were not able to obtain intravenous (IV) access, and two immediate attempts at IV cannulation failed in the emergency department (ED). What should be the next step in the patient's management?
- A. Albuterol, 2.5 mg nebulized
  - B. Central venous catheter placement, then D<sub>50</sub>W IV
  - C. Epinephrine, 1 mg IV
  - D. Glucagon, 2 mg intramuscularly
  - E. Peripheral IV catheterization via cutdown and then D<sub>50</sub>W

**Answer: D.** Intravenous dextrose (25–75 g for adults, 0.5–1 g/kg for children) is preferable but, if unable to obtain IV access, administer glucagon, 1 or 2 mg intramuscularly (IM) or subcutaneously (SC; 0.025–0.1 mg/kg IM or SC in children). Onset of action is 10 to 20 minutes. It is ineffective in cases of glycogen absence, such as alcohol-induced hypoglycemia.

- 118.5.** A 33-year-old juvenile-onset, insulin-dependent diabetic suddenly faints without prodrome or warning while walking through the ED. Relatives report that diabetes is his only past history. Which of the following findings is most likely?
- A. Autonomic neuropathy on later orthostatic testing
  - B. Fingerstick glucose 27 mg/dL
  - C. Hemocult-positive stool
  - D. Positive enzyme-linked immunosorbent assay (ELISA) D-dimer
  - E. Supraventricular tachycardia on electrocardiogram (ECG)

**Answer: B.** Hypoglycemia without warning, or hypoglycemia unawareness, is a complication of type 1 diabetes caused by previous hypoglycemic episodes. A single hypoglycemic episode may blunt neurohormonal counterregulatory responses to later hypoglycemic episodes. Risk factors are overaggressive insulin therapy, longer history of diabetes, and autonomic neuropathy, which usually causes orthostasis on first standing or after being upright in a static position. These patients may become abruptly unaware without warning.

**118.6.** A 47-year-old man presents with hypoglycemia. He is a known type 2 diabetic on glyburide. Fingerstick glucose is 27 mg/dL. Twenty minutes after two ampules (50 g) of dextrose, his glucose level is 29 mg/dL. Which of the following agents is indicated?

- A. Adenosine
- B. Epinephrine
- C. Glucagon
- D. Hydrocortisone
- E. Octreotide

**Answer: E.** A patient with hypoglycemia from sulfonylureas, in addition to standard glucose replacement, frequently requires treatment with an agent to inhibit further insulin release, such as octreotide (a somatostatin analogue). Sulfonylureas are insulin secretagogues.

**118.7.** What is the most important determinant of mental status in a patient with diabetic ketoacidosis (DKA)?

- A. Acidemia
- B. Calcium level
- C. Glucose level
- D. Osmolarity
- E. Potassium level

**Answer: D.** The hyperosmolarity produced by dehydration and hyperglycemia is the most important determinant of mental status during an episode of DKA.

**118.8.** A 73-year-old male patient presents with a draining sore on the bottom of his foot. He is noted to have a 3- × 4-cm ulcerated, malodorous lesion on his plantar foot, with surrounding erythema. Which antimicrobial agent should be included as part of the management of this infection?

- A. Cefazolin, 1 g qid
- B. Ceftriaxone, 1 g every 24 hours
- C. Levofloxacin, 500 mg every 24 hours
- D. Metronidazole, 500 mg qid
- E. Piperacillin/tazobactam, 3.375 g qid

**Answer: E.** Piperacillin/tazobactam and vancomycin are considered the first-line agents for management of complicated diabetic foot infections.

**118.9.** A 43-year-old patient is brought to the ED with altered mental status. Other past history is unavailable, there are no signs of trauma, and the physical examination is normal except for the patient's mental status. Laboratory assessment reveals the following:

Sodium = 132 mEq/L  
Potassium = 3.0 mEq/L  
Chloride = 82 mEq/L  
Bicarbonate = 36 mEq/L  
Creatinine = 1.4 mg/dL  
Blood urea nitrogen (BUN) = 26 mg/dL  
Urine ketones—trace positive  
Arterial blood gases (ABG)  
Po<sub>2</sub> = 90 mm Hg,  
Pco<sub>2</sub> = 30 mm Hg  
pH = 7.49

What additional finding is the most likely?

- A. Elevated glucose level
- B. Elevated iron level
- C. Elevated salicylate level
- D. Evidence of toluene ingestion
- E. History of alcohol abuse

**Answer: E.** The finding of alkalemia with ketoacidosis should prompt the consideration of alcoholic ketoacidosis, in which the acidosis is counterbalanced by alkalosis from severe nausea and vomiting. This may also be seen with DKA but is less likely.

**118.10.** What percentage of cases of DKA occur in patients whose diabetes was previously undiagnosed?

- A. 10%
- B. 25%
- C. 50%
- D. 75%
- E. 90%

**Answer: B.** 25%.

**118.11.** A 28-year-old juvenile-onset diabetic presents in DKA. Laboratory assessment reveals a sodium level of 130 mEq/L and serum glucose level of 700 mg/dL. What is the approximate total serum sodium value?

- A. 125 mEq/L
- B. 130 mEq/L
- C. 135 mEq/L
- D. 139 mEq/L
- E. 144 mEq/L

**Answer: D.** The true value of sodium may be approximated by adding 1.6 mEq/L to the reported sodium value for every 100-mg/dL glucose over the norm.

**118.12.** A 31-year-old insulin-dependent diabetic presents in DKA. His reported serum potassium level is 5 mEq/L, with a pH of 6.90. What is his corrected potassium level value?

- A. 2 mEq/L
- B. 2.5 mEq/L
- C. 3 mEq/L
- D. 3.5 mEq/L
- E. 4 mEq/L

**Answer: A.** The effect of acidosis on the serum potassium can be corrected by subtracting 0.6 mEq/L from the laboratory potassium value for every 0.1 decrease in pH noted on the ABG analysis. For this patient, assuming a normal pH of 7.40,  
 $7.40 - 6.90 = 0.5$  (five 0.1 pH increments)  
 $5 \times 0.6 = 3$  mEq/L correction factor

**118.13.** Which of the following statements regarding the laboratory evaluation of DKA is true?

- A. Amylase levels maintain their sensitivity for detecting pancreatitis.
- B. Creatinine levels may be falsely elevated.
- C. Hypertriglyceridemia is unusual.
- D. Leukocytosis is often present in the absence of infection.
- E. True magnesium levels may be estimated by a conversion factor.

**Answer: B.** Serum creatinine levels may be falsely elevated if measured by autoanalyzer. No conversion factor exists for estimating magnesium. Leukocytosis typically parallels the degree of ketosis. A bandemia, however, indicates the presence of infection, with a sensitivity of 100% and specificity of 80%. Elevated triglyceride levels are seen routinely. Elevated amylase levels (salivary) are routinely seen; however, lipase maintains its sensitivity for pancreatitis.



- 118.14.** Alcoholic ketoacidosis accounts for what percentage of all cases of ketoacidosis?
- A. 10%
  - B. 20%
  - C. 30%
  - D. 40%
  - E. 50%

**Answer: B.** Ketoacidosis may also develop with fasting in the third trimester of pregnancy and in nursing mothers who do not eat well.

- 118.15.** A 26-year-old known diabetic presents with altered mental status. EMS reports a fingerstick glucose of 750 mg/dL. The patient vomited once en route. The physical examination is remarkable for a comatose patient with the following vital signs—respiratory rate, 30 breaths/min; heart rate, is 140 beats/min; blood pressure, 85/40 mm Hg. Which of the following should be the first intervention?
- A. Dopamine, 10 µg/kg/min
  - B. Endotracheal intubation
  - C. Isotonic fluid bolus, 20 mL/kg
  - D. Regular insulin 0.1 units/kg IV
  - E. Sodium bicarbonate IV

**Answer: B.** The comatose DKA patient, especially if vomiting, requires intubation. Hyperventilation should be rapidly initiated to prevent worsening acidosis. Isotonic fluid resuscitation, insulin bolus and infusion, and meticulous attention to electrolyte management must follow.

- 118.16.** What is the half-life of regular insulin when administered intravenously?
- A. 3–10 minutes
  - B. 10–15 minutes
  - C. 15–20 minutes
  - D. 20–25 minutes
  - E. 25–30 minutes

**Answer: A.** With a half-life of only 3 to 10 minutes, regular insulin requires an infusion rather than intermittent bolus therapy for optimal effect.

- 118.17.** A patient with severe DKA is treated with fluid resuscitation and an insulin infusion. Six hours later, the patient develops confusion, disorientation, and hypercarbia from altered respiratory muscle performance. A repeat serum glucose level is 193 mg/dL. Which of the following treatments is most appropriate?
- A. Calcium replenishment
  - B. Magnesium replenishment
  - C. Phosphorus replenishment
  - D. Potassium replenishment
  - E. Sodium bicarbonate replenishment

**Answer: C.** Phosphorus levels may fall dramatically after initiation of standard DKA therapy. Hypophosphatemia may cause a left shift in the hemoglobin desaturation curve, depressed

myocardial and respiratory muscle function, hemolysis, thrombocytopenia, platelet dysfunction, confusion, and disorientation. Cerebral edema would be in the differential diagnosis because it also occurs in the 6- to 10-hour range after initiating therapy.

- 118.18.** Which of the following is not associated with cerebral edema after DKA?
- A. Bicarbonate therapy
  - B. Blood glucose level > 350 mg/dL
  - C. Elevated BUN level
  - D. Hypocarbica
  - E. Onset 6 to 10 hours after initiation of therapy

**Answer: B.** Clinically evident cerebral edema does not usually occur unless the blood glucose level is less than 250 mg/dL and insulin is being used. The other listed factors are associated with this syndrome.

- 118.19.** Which of the following may be associated with or cause the hyperglycemic hyperosmolar state (HHS)?
- A. All of these
  - B. Anion gap metabolic acidosis
  - C. Chlorpropamide use
  - D. Choreoathetosis and segmental myoclonus
  - E. Confusion with depressed sensorium from hypoglycemia

**Answer: A.** HHS may be associated with many drugs and illnesses. Symptoms range from lethargy to focal neurologic changes and seizure or coma. Initial differentiation from hypoglycemic coma may be difficult until serum glucose levels are checked. Metabolic acidosis is not uncommon and may yield an elevated anion gap—lactic acidosis, starvation, and retention of inorganic acids. HHS may occur in nondiabetics after burns or peritoneal hemodialysis.

- 118.20.** A 69-year-old patient presents with new-onset seizures, serum glucose level of 850 mg/dL, and serum osmolality of 340 mOsm/L. His past history is remarkable for chronic renal insufficiency resulting from hypertension. His only current medications are amlodipine and furosemide. Which of the following statements regarding the patient's condition is true?
- A. Emergent dialysis is indicated.
  - B. Furosemide may have precipitated this event.
  - C. Heparin has no therapeutic role.
  - D. Insulin is contraindicated in cases of renal insufficiency.
  - E. Phenytoin is indicated.

**Answer: B.** Regardless of the cause, the management of the hyperosmolar hyperglycemic state (HHS) centers on aggressive fluid management and low-dose insulin. Phenytoin is contraindicated in hyperosmolar hyperglycemic nonketotic coma (HHNC) because of its impairment of endogenous insulin release and ability to precipitate HHNC. Low-dose heparin may be indicated to lessen the risk of thrombosis. Furosemide is one of many drugs that may precipitate HHNC.

## KEY CONCEPTS

- Rhabdomyolysis is generally a benign syndrome, but with potentially fatal complications. Acute renal failure and hyperkalemia are accompanied by high mortality.
- Rhabdomyolysis should be suspected in at-risk patients (see [Box 119.1](#)) who present with muscle pain or altered mentation.
- The diagnosis of rhabdomyolysis is confirmed with an elevated serum CK level ( $>1000$  U/L).
- In patients with rhabdomyolysis, the degree of CK elevation is not a reliable predictor of risk of acute renal injury.
- IV fluid administration should be aimed at maintaining a urine output of at least 300 mL/hr in the average-sized adult patient with rhabdomyolysis.
- Diuretics have no role in the management of most cases of rhabdomyolysis.
- Survivability hinges on prompt recognition and resuscitation with a liberal fluid strategy, with or without urine alkalinization.

## CHAPTER 119: QUESTIONS &amp; ANSWERS

- 119.1.** Which of the following statements regarding muscle cell physiology and rhabdomyolysis is true?
- Acute renal failure from rhabdomyolysis is very rare.
  - Hemoglobin has a higher oxygen affinity than myoglobin.
  - The final common pathway of injury in rhabdomyolysis is cell membrane damage.
  - The normal intracellular  $\text{Na}^+$  concentration is high.
  - The normal intracellular  $\text{Ca}^{2+}$  concentration is low.

**Answer: E.** Normal intracellular concentrations of  $\text{Na}^+$  are low, creating a negative intracellular environment. This allows more facilitated transfer of  $\text{Ca}^{2+}$  from the intracellular to extracellular space, maintaining low intracellular  $\text{Ca}^{2+}$  concentrations. The final common pathway of injury is sarcolemma damage with intracellular  $\text{Ca}^{2+}$  accumulation, proteolytic enzyme inhibition, actin-myosin coupling dysfunction, and cell damage with release of intracellular contents (eg, myoglobin,  $\text{PO}_4$ , uric acid, lactate dehydrogenase). Myoglobin, which has four times the  $\text{O}_2$  affinity of hemoglobin, overwhelms the haptoglobin-binding capacity, is filtered at the glomerulus, and precipitates in renal tubules. Approximately 5% to 15% of cases of acute renal failure in the United States are related to rhabdomyolysis. This myoglobin precipitation is markedly facilitated by acidosis.

- 119.2.** Which of the following statements regarding exertion (exercise)-related rhabdomyolysis is true?
- Eccentric (lengthening) muscle work is more damaging than concentric.
  - Hypocalcemia increases the risk for this syndrome.
  - It is the result of voluntary muscle exertion.
  - It is seen exclusively in untrained athletes.
  - The mechanism is different than after a crush injury.

**Answer: A.** Exertional rhabdomyolysis is seen in trained and untrained individuals as well as after exercise or situations of involuntary muscle activity (eg, psychoses, seizures, tetany, myoclonus). The mechanism (eg, failure of energy supplies, sarcolemma breakdown, intracellular calcium accumulation, enzyme dysfunction, cellular swelling) is the same. Hypokalemia is a risk factor because a low potassium level limits microvascular dilation and muscle perfusion.

- 119.3.** Which of the following statements regarding drug-induced rhabdomyolysis is true?
- Cocaine myotoxicity is not related to the degree of intoxication.
  - Colchicine and cyclosporine are myotoxins.
  - Ethanol myotoxicity is potentiated by high carbohydrate intake.
  - Statin myotoxicity is unrelated to state of hydration.
  - The use of the drug ecstasy is not associated with rhabdomyolysis.

**Answer: B.** Statins, ethanol, cocaine, colchicine, cyclosporine, and many other drugs are myotoxic. Illicit drugs include amphetamine, ecstasy, LSD, and other sympathomimetics. Ethanol is a direct muscle membrane toxin, and this effect is potentiated by starvation, binge drinking, and coexisting electrolyte abnormalities (low  $\text{K}^+$ ,  $\text{PO}_4$ , and  $\text{Mg}^{2+}$ ). Intravenous cocaine use is more myotoxic than inhaled cocaine, and the severity seems to parallel the degree of intoxication.

- 119.4.** What is the most common viral cause for rhabdomyolysis?
- Cytomegalovirus
  - Epstein-Barr virus
  - Herpesvirus
  - Human immunodeficiency virus
  - Influenza virus

**Answer: E.** Influenza is the most common viral etiology followed by HIV infection and enteroviral infection.

- 119.5.** What is the most common bacterial cause for rhabdomyolysis?
- Legionella*
  - Pseudomonas*
  - Salmonella*
  - Staphylococcus*
  - Streptococcus*

**Answer: A.** *Legionella* is the bacterium classically associated with rhabdomyolysis in adult patients. The pathogenesis is believed to be due to direct invasion and toxic degeneration of muscle fibers.

**119.6.** Which of the following electrolyte abnormalities has not been associated with rhabdomyolysis?

- A. Hypermagnesemia
- B. Hypernatremia
- C. Hypocalcemia
- D. Hyponatremia
- E. Hypophosphatemia

**Answer: A.** There are no reported cases of hypermagnesemia induced rhabdomyolysis to date.

**119.7.** A 53-year-old intoxicated alcoholic is brought to the ED by EMS after being found unconscious for an unknown reason. He is now awake but mildly lethargic. He has no complaints of pain or disability. The physical examination is nonfocal. Which of the following statements is true?

- A. A CK-MB fraction of 5% would indicate myocardial damage.
- B. A negative urine myoglobin level would exclude rhabdomyolysis.
- C. His lack of pain complaints would exclude rhabdomyolysis.
- D. Hypocalcemia would be expected in the presence of rhabdomyolysis.
- E. If rhabdomyolysis were found, normal phosphate level would be reassuring.

**Answer: D.** Hypocalcemia is the most common electrolyte abnormality after rhabdomyolysis. Hypercalcemia may follow later. Only 50% of patients with serum evidence of rhabdomyolysis have complaints of muscle pain. Likewise, the presence of urine myoglobin reflects the glomerular filtration rate, plasma myoglobin concentrations, urine flow, and plasma myoglobin binding. This test result may be negative, especially late in the course of the process. Hyperphosphatemia is expected, and a normal level raises the suspicion that hypophosphatemia was the cause of the rhabdomyolysis. CK-MB levels of 3% to 5% are often seen and reflect skeletal rather than cardiac muscle damage.

**119.8.** Which of the following is a proven cornerstone of management for rhabdomyolysis, along with saline hydration?

- A. Alkalinization
- B. Chelation therapy
- C. Furosemide
- D. Mannitol
- E. None of the above

**Answer: E.** Furosemide is somewhat contraindicated because of its tendency to acidify the urine. Mannitol and alkalinization are not proven, although they are often used. Chelation therapy is under investigation.

## KEY CONCEPTS

**Hyperthyroidism**

- Thyroid hormone exerts effects on nearly every organ system. A high degree of suspicion is needed to diagnose hyperthyroidism.
- The laboratory evaluation of choice is determination of the TSH concentration with free  $T_4$  and  $T_3$  levels. Total  $T_4$  and  $T_3$  levels are of limited value.
- Thyroid storm is a life-threatening thyrotoxic crisis that requires prompt recognition and therapy, as well as identification and treatment of any precipitating cause, such as infection.
- The order of medication administration in thyroid storm is critical. Iodine can precipitate thyroid storm and must be given a minimum of 1 hour after thionamide therapy (PTU or methimazole). As such, the typical order is beta blocker (propranolol), PTU, or methimazole, and then iodine (SSKI, Lugol's solution).

**Hypothyroidism**

- Hypothyroidism results from lack of stimulation of the thyroid gland (central or secondary hypothyroidism) or intrinsic gland dysfunction limiting hormone production (primary hypothyroidism).
- Signs and symptoms of hypothyroidism range from asymptomatic to overt organ failure, which can lead to death.
- Determination of an elevated TSH level is the most sensitive and single best screening test to confirm the diagnosis of primary hypothyroidism.

- Replacement with levothyroxine ( $T_4$ ) remains the treatment of choice and resolves most physical and psychological signs and symptoms in most patients.
- Myxedema coma is a life-threatening event that is most often precipitated by some stressful event in patients with untreated or undertreated hypothyroidism. Treatment with thyroid hormone replacement must be initiated, often solely on clinical findings.

**Adrenal Insufficiency**

- Clinical manifestations of primary and secondary adrenal insufficiency may be vague and nonspecific and require a high index of suspicion for diagnosis.
- Predominant complaints include fatigue, weakness, dizziness, nausea, vomiting, and other nonspecific GI symptoms.
- Patients with primary adrenal insufficiency characteristically have more pronounced clinical manifestations and skin hyperpigmentation. Measurement of cortisol in the ACTH stimulation test is the standard and most convenient method to assist in confirming the diagnosis.
- Refractory hypotension in the acutely ill patient may be the only clue to adrenal insufficiency and is readily treated with the IV administration of glucocorticoids (dexamethasone, 4 mg, or hydrocortisone, 100 mg).

## CHAPTER 120: QUESTIONS &amp; ANSWERS

**120.1.** Which of the following is the single best test to assess thyroid function?

- A. Free  $T_3$
- B. Free  $T_4$
- C. Total  $T_3$
- D. Total  $T_4$
- E. TSH

**Answer: E.** Reliable assays for serum TSH and free  $T_4$  have made the laboratory diagnosis of hyperthyroidism straightforward. Measurement of the serum TSH level is the single best test to assess thyroid function. A normal TSH level excludes hyperthyroidism, and an elevated TSH level is generally diagnostic for hypothyroidism.

**120.2.** What is the most common cause of hyperthyroidism in the United States?

- A. Graves' disease
- B. Hashimoto thyroiditis
- C. Hot nodule (toxic adenoma)
- D. Multinodular goiter
- E. Subacute thyroiditis

**Answer: A.** In the United States, Graves' disease (diffuse toxic goiter) is the most common form of hyperthyroidism.

**120.3.** In thyroid storm, which of the following is the proper sequence of drug administration?

- A. All three together (antithyroid drugs, sodium or potassium iodide, steroid) at the same time
- B. Antithyroid drugs, sodium or potassium iodide, steroid
- C. Sodium or potassium iodide, steroid, antithyroid drugs
- D. Steroid, sodium or potassium iodide, antithyroid drugs

**Answer: B.** Because an iodine load can increase the synthesis of thyroid hormone, it should not be administered until 1 hour after the initiation of antithyroid drugs (PTU or methimazole therapy).

**120.4.** Which of the following medications may cause hypothyroidism secondary to the inhibition of the peripheral conversion of  $T_4$  to  $T_3$ ?

- A. Amiodarone (Cordarone)
- B. Digoxin (Lanoxin)
- C. Dopamine (Intropin)
- D. Phenytoin (Dilantin)
- E. Propranolol (Inderal)

**Answer: A.** Amiodarone is a class III antiarrhythmic medication that has a similar chemical structure to  $T_4$  and contains large amounts of iodine. As such, it inhibits the peripheral conversion of  $T_4$  to  $T_3$  leading to hypothyroidism. In addition, amiodarone is directly cytotoxic to the thyroid, has the intrinsic effect of blocking thyroid hormone entry into cells, and decreases  $T_3$  receptor binding. If amiodarone therapy must be continued for arrhythmia control, patients with amiodarone-induced hypothyroidism may be successfully treated with exogenous thyroid hormone replacement.

**120.5.** Cardiovascular manifestations of subclinical hypothyroidism include which of the following?

- A. Advanced atherosclerotic plaque formation
- B. Cardiac conduction abnormalities
- C. Decreased peripheral vascular resistance
- D. Labile hypertension
- E. Increased ejection fraction

**Answer: A.** Hypothyroidism is responsible for multisystem organ pathology. Even mild thyroid failure is a significant risk factor for the development of arterial stiffness from impaired endothelial function and artery intima-media wall thickening.

Arterial stiffness is an important determinant of premature atherosclerosis and changes in arterial wall elasticity.

The accelerated atherosclerosis in hypothyroidism is ascribed to dyslipidemia, diastolic hypertension, and impaired endothelial function. Additionally,  $T_3$  increases production and secretion of renin. In patients who are hypothyroid, renin levels are found to be low, which plays an important role in the acceleration of atherogenesis.

**120.6.** In a patient with suspected adrenal crisis, what is the treatment of choice for hypotension refractory to isotonic fluid replacement?

- A. Adrenocorticotrophic hormone (ACTH)
- B. Continued normal saline (0.9%) fluid boluses
- C. Dobutamine (Dobutrex)
- D. Dopamine (Intropin)
- E. Hydrocortisone (Solu-Cortef)

**Answer: E.** Acute manifestations of disease may result in severe and possibly refractory hypotension. Refractory hypotension in

the acutely ill patient may be the only clue to adrenal insufficiency and is readily treated with IV glucocorticoids (dexamethasone, 4 mg, or hydrocortisone, 100 mg IV).

**120.7.** Laboratory confirmation of adrenal insufficiency is performed by measuring the level which of the following?

- A. Adrenocorticotrophic hormone (ACTH)
- B. Aldosterone
- C. Corticotropin-releasing hormone (CRH)
- D. Cortisol

Melanocyte-stimulating hormone

**Answer: D.** Maintaining a high index of suspicion for adrenal insufficiency is of primary importance. Several tests are available to assist in confirmation. Whether screening for chronic disease or working up an acutely ill patient, cortisol level measurement is the mainstay of making an accurate diagnosis.



## KEY CONCEPTS

- All patients appearing septic should be treated with broad-spectrum antibiotics as soon as possible, even before a definitive diagnosis is made.
- A surgeon should be consulted as soon as possible for patients with sepsis and a débridable source of infection.
- Immunity to diphtheria, tetanus, and pertussis wanes significantly in adults. Pertussis should be considered a cause of persistent cough in adults. A tetanus vaccination history should always be obtained from patients with trauma or infection. When there is doubt about the history, the age-appropriate vaccine according to CDC guidelines is administered.
- Neonates with suspected pertussis should be admitted to an intensive care setting.
- Botulism should be kept in the differential diagnosis for the infant with failure to thrive, constipation, or decreased muscle tone and for the injection drug user with neurologic symptoms.
- Patients with pneumococemia, meningococemia, and TSS can decompensate rapidly. Antimicrobial therapy should be initiated promptly, before identification of an organism.

## CHAPTER 121: QUESTIONS &amp; ANSWERS

**121.1.** An 18-year-old male Hispanic immigrant presents with acute-onset sore throat, fever, and weakness. He has no past medical history. Examination is remarkable for a grayish white exudative coat over both tonsils and the posterior pharynx. There is modest neck swelling with cough, low-grade fever, and hoarseness. Rapid strep testing and monospot results are negative. Which of the following statements regarding this patient's disease is *true*?

- A. Emergent antibiotics and corticosteroids are the main therapy.
- B. Neuromuscular examination is critical.
- C. Rapid treatment will obviate the need for intubation.
- D. The electrocardiogram (ECG) is a sensitive indicator of myocarditis.
- E. The highest mortality occurs in the presence of myocarditis.

**Answer: B.** Diphtheria can be a more benign upper respiratory/nasal infection or a “malignant” process with airway obstruction, myocarditis, and neuropathy (palate is involved first; the only cells spared are cortical). Antibiotics stop further organism growth, but diphtheria equine antitoxin is the key to therapy. Death is usually from myocarditis or airway obstruction, with the highest mortality seen in patients with the “bull neck” appearance. The ECG is an insensitive indicator of myocarditis.

**121.2.** An 11-year-old child presents with coughing paroxysms for 10 days. This was preceded by a mild upper respiratory tract infection. The paroxysms occur multiple times per day and have occasionally caused vomiting. The child is relatively well between paroxysms. Vaccination history is sketchy. Which of the following statements regarding this patient's disease is *true*?

- A. Antibiotics will shorten illness duration.
- B. Erythromycin should be given to unimmunized contacts.
- C. Fever is expected.
- D. Thoracic petechiae should prompt a septic evaluation.
- E. Throat culture is diagnostic.

**Answer: B.** Pertussis, caused by a gram-negative bacterium, is a three-phase illness: catarrhal (upper respiratory tract infection), paroxysmal, and convalescence of weeks to months. The coughing phase is characterized primarily by complications related to the paroxysms, such as subconjunctival hemorrhage, pneumomediastinum, headache, rectal prolapse, chest wall petechiae, and even seizures. Fever is rare unless there is secondary infection. Antibiotics only reduce the carrier state. Corticosteroids may help younger children. Antibiotic prophylaxis is indicated for nonimmunized contacts. Nasal culture is diagnostic. Standard cough suppressants are ineffective.

**121.3.** After which of the following circumstances has tetanus been reported?

- A. Childbirth
- B. Chronic skin ulcers
- C. Corneal abrasion
- D. Otitis media
- E. All of the above

**Answer: E.** It has also been reported after dental procedures, abortions, and intestinal operations. In these cases, the source of the bacteria is endogenous because up to 10% of humans harbor *Clostridium tetani* in the colon.

**121.4.** Which of the following statements concerning the tetanus neurotoxin (tetanospasmin) is *true*?

- A. A shorter incubation period portends a better prognosis.
- B. It blocks presynaptic release of gamma-aminobutyric acid (GABA).
- C. Sensory nerves are blocked, followed by motor nerves.
- D. Synaptic binding is reversible and overcome by acetylcholinesterase therapy.
- E. The autonomic nervous system is relatively spared.

**Answer: B.** The toxin migrates in the motor nerve from the injury site to the central nervous system (CNS). Presynaptic release of the inhibitory neurotransmitter GABA and glycine is diminished. The unopposed excitatory action results in muscle spasm. Presynaptic inhibition of the autonomic nervous system is also lost, and wide heart rate and blood pressure fluctuations are seen. The toxin binding is irreversible and diminishes only with axon synaptic regeneration. A shorter incubation period is a harbinger of a worse outcome.

**121.5.** A 62-year-old male farmer with no medical problems presents with leg pain and muscle spasms. He reports moderate to severe pain and muscle spasms in the calf that have occurred and worsened during 3 days. Two weeks prior, he suffered a puncture wound to his ankle just above his boot top with a piece of metal. Examination is remarkable for a heart rate of 115 beats/minute, blood pressure of 170/110 mm Hg, and a healing clean wound above the medial malleolus with no evidence of active infection. The calf is in active spasm with some increased tone in the peroneal musculature also. Which of the following statements regarding this patient's disease is *true*?

- A. A radiograph should be obtained to assess for subcutaneous air.
- B. Admission for intravenous (IV) antibiotics is indicated.

- C. Lumbar spine magnetic resonance imaging (MRI) is indicated.
- D. Outpatient management is indicated.
- E. Tetanus immune globulin is indicated.

**Answer: E.** Localized tetanus reflects a local neuromuscular process with pain and spasm. It is likely due to a partial immunity. Immune globulin is indicated. Although mortality is lower, it can progress to generalized tetanus, and admission is warranted.

- 121.6.** Generalized tetanus may be confused with which of the following conditions?
- A. Malignant hyperthermia
  - B. Neuroleptic malignant syndrome
  - C. Organophosphate poisoning
  - D. Serotonin syndrome
  - E. Strychnine poisoning

**Answer: E.** Strychnine poisoning is the only clinical condition that mimics generalized tetanus. Strychnine, like tetanus toxin, antagonizes glycine release but has no gamma-aminobutyric acid (GABA) effect. Patients develop opisthotonos while remaining alert. The annual incidences of the two processes are similar. Serum and urine strychnine tests should be performed when tetanus is suspected.

- 121.7.** Which of the following statements regarding botulism is *true*?
- A. It does not affect the autonomic nervous system.
  - B. The gastrointestinal system is spared.
  - C. The syndrome may mimic Guillain-Barré syndrome onset.
  - D. The toxin has its primary effect at the spinal cord.
  - E. Urinary retention may occur.

**Answer: E.** The toxin blocks the presynaptic release of acetylcholine at peripheral and autonomic nerve junctions. This proceeds in a descending manner, ultimately resulting in both a muscarinic and a nicotinic anticholinergic syndrome with muscle weakness, cranial nerve dysfunction, and diffuse parasympathetic diminution with constipation, ileus, and urinary retention. The descending, “cranial nerve first” pattern is opposite the ascending Guillain-Barré syndrome picture. Orthostatic hypotension may be profound.

- 121.8.** Which of the following statements regarding wound and food-borne botulism is *true*?
- A. Incubation times are similar.
  - B. The sequence of neural involvement is different.
  - C. Wound botulism affects central nervous system (CNS) gamma-aminobutyric acid (GABA) tone.
  - D. Wound botulism does not have gastrointestinal involvement.
  - E. Wound botulism is more common.

**Answer: D.** Wound botulism also has a longer incubation period.

- 121.9.** A 31-year-old man presents with double vision and difficulty swallowing. He has no medical history and takes no medication. Your examination is remarkable for bilateral ptosis, mildly dilated pupils, dry mucous membranes, difficulty swallowing, and weakness of the trapezius and deltoid muscles. Bowel sounds are absent. Vital signs are temperature, 97.3° F (36.3° C); heart rate, 93 beats/minute; blood pressure, 84/63 mm Hg; and respiratory rate, 20 breaths/minute. Which of the following is indicated?
- A. Antitoxin
  - B. Blood cultures and antibiotics
  - C. Lumbar puncture
  - D. Magnetic resonance imaging (MRI) of the brain and spine

**Answer: E.** Organophosphate treatment  
**Answer: A.** Botulism presents as a descending paralysis/anticholinergic syndrome. Autonomic dysfunction with orthostatic hypotension is common. Ileus and urinary retention may occur. Antitoxin, intensive care unit (ICU) admission, and early intubation are often indicated.

- 121.10.** Fever and a nonblanching rash should suggest which of the following?
- A. Disseminated tuberculosis
  - B. Meningococemia
  - C. Plague
  - D. Pneumococcal sepsis
  - E. Tularemia

**Answer: B.** Up to 30% of meningococemia patients will present with this picture and no immediate evidence of meningitis or sepsis.

## KEY CONCEPTS

- There have been recent outbreaks of vaccine-preventable childhood infections secondary to unvaccinated individuals and travel to areas where disease is still endemic. Emergency clinicians should recognize the possibility of these once rare diseases.
- Herpes simplex encephalitis is a severe disease that is fatal if left untreated. Clinicians should suspect this diagnosis when evaluating severely ill patients for suspected meningitis or encephalitis, and promptly institute empirical therapy with IV acyclovir while awaiting diagnostic results.
- Primary varicella can be dangerous in select populations, including older children, adults, and pregnant patients. These patients require treatment with acyclovir.
- Zoster patients should be treated with acyclovir if they present within 72 hours of symptoms onset or if they are immunocompromised regardless of duration of illness. Disseminated zoster should be treated with IV acyclovir.
- In generally healthy patients with influenza infection, the duration of illness can be shortened by almost 1 day if antiviral treatment is administered within 48 hours of symptom onset. Hospitalized patients with influenza infection should be treated with antiviral medication regardless of duration of symptoms, because it may decrease mortality and influenza complications.
- There are many emerging viral infections including SARS-CoV, MERS-CoV, and Ebola that should be considered in febrile patients. It is important to identify patients at risk by determining travel history and exposure history to individuals with confirmed infection. Once a patient is deemed at risk, the patient should be promptly isolated according to established guidelines while further investigation occurs. It is also important to immediately inform the hospital infection control program and public health agencies.

## CHAPTER 122: QUESTIONS &amp; ANSWERS

- 122.1. Which of the following patients does not require antiviral treatment for confirmed influenza infection?
- 1-year-old male with 24 hours of symptoms.
  - 22-year-old otherwise healthy female with symptoms for 3 days.
  - 25-year-old male with a history of asthma and morbid obesity with symptoms for 2 days.
  - 35-year-old male with no significant past medical history with symptoms for 5 days, intubated with severe hypoxemic respiratory failure, admitted to the intensive care unit (ICU).
  - 65-year-old male with history of asthma, coronary artery disease, congestive heart failure with 2 days of mild symptoms.

**Answer: B.** The 22-year-old female with no risk factors for influenza related complications does not require antiviral treatment since her symptoms have been present for 4 days. The Centers for Disease Control and Prevention (CDC) recommends treating all patients as early as possible who are hospitalized, have severe illness, or are at risk for influenza related complications. The greatest efficacy for antiviral treatment is within 48 hours of symptom onset, but admitted patients with severe disease should be treated regardless of symptom onset.

- 122.2. A 19-year-old female presents to the emergency department (ED) with fever, altered mental status, and seizures. She is a college student and lives in a dormitory. Her only past medical history is occasional cold sores. She had been in her usual state of health until 2 days ago when she developed fevers up to 38.5°C and headache. Today she became more lethargic and had two generalized seizures prior to ED arrival. What is the next best course of action?
- Administer 2 g intravenous (IV) ceftriaxone, 1 g IV vancomycin, IV acyclovir 10 mg/kg every 8 hours, order computed tomography (CT) scan of head, and then perform lumbar puncture (LP).
  - Administer 2 g IV ceftriaxone and admit to internal medicine service for further evaluation.
  - Administer 650 mg acetaminophen, 2 liters of IV fluids, and admit to the observation unit with the diagnosis of viral syndrome.
  - Order magnetic resonance imaging (MRI) of the brain, administer 1 g phenytoin, and consult neurology.
  - Prescribe 1 g valacyclovir twice daily for 10 days and 650 mg acetaminophen every 4 to 6 hours as needed and discharge home.

**Answer: A.** This patient has herpes simplex virus (HSV) encephalitis. Given the high mortality associated with this condition, antiviral therapy should be started as soon as the diagnosis is suspected. There is significant overlap in the clinical presentation of bacterial meningitis and HSV encephalitis, so patients should empirically be treated for both diagnoses while awaiting cerebrospinal fluid (CSF) results. HSV encephalitis cannot be treated as an outpatient and requires 14 to 21 days of treatment with IV acyclovir. An MRI may be necessary eventually to look for temporal lobe involvement but is not necessary at the time of ED presentation and can be negative early in the course of disease.

- 122.3. Which of the following associations is correct?
- Chikungunya virus—viral hemorrhagic fever
  - Ebola virus—febrile illness with severe arthralgias and myalgias
  - Herpes simplex virus type 1 (HSV-1)—benign meningitis
  - Herpes simplex virus type 2 (HSV-2)—necrotizing hemorrhagic encephalitis
  - Middle East respiratory syndrome—coronavirus (MERS-CoV)—severe acute respiratory failure

**Answer: E.** MERS-CoV causes an acute respiratory illness with fever, cough, and dyspnea. HSV-1 causes necrotizing hemorrhagic encephalitis, typically involving the temporal lobes. HSV-2 can cause meningitis in over 25% of patients with primary infection. In contrast to HSV encephalitis, HSV meningitis has a benign course. Ebola virus causes a severe hemorrhagic fever. Chikungunya causes a self-limiting disease with fever, myalgias, and polyarthralgias.

- 122.4. An 18-year-old male who arrived from Sierra Leone 2 weeks ago presents with fever, headache, vomiting, and rash. He has a temperature of 103.1°F (39.5°C) and erythematous maculopapular rash over his trunk, back, and arms. He appears ill and severely dehydrated. Which of the following is immediately indicated?
- 2 g ceftriaxone and lumbar puncture (LP)
  - Intravenous (IV) acyclovir for 10 days
  - Isolation and contact the public health department
  - Ribavirin
  - Thin and thick smear to check for malaria

**Answer: C.** This is a classic presentation for Ebola virus disease (EVD). The exposure history is important. Patients should be asked if they have lived or travelled to a country with Ebola or had contact with a confirmed EVD patient in the past 21 days. If the answer is yes, then the next task is to assess for any signs or symptoms compatible with Ebola, including fever, headache, weakness, myalgias, vomiting, diarrhea, abdominal pain, or hemorrhage. Once a patient has been screened positive as a potential EVD patient, he or she should be immediately isolated and hospital infection control and the health department should be notified at once.

**122.5.** Which of the following viruses is not transmitted by a mosquito vector?

- A.** Chikungunya virus
- B.** Dengue virus
- C.** Lassa fever virus
- D.** West Nile virus (WNV)
- E.** Yellow fever virus

**Answer: C.** The reservoir for the Lassa virus is an African rodent *Mastomys natalensis*. Humans contract the disease by exposure to urine or feces of *Mastomys natalensis*. Human to human transmission can occur via contact with blood or bodily secretions from infected humans. The other viruses are all arboviruses transmitted via a mosquito vector.

## KEY CONCEPTS

- Postexposure prophylaxis (PEP) for rabies should be administered to individuals exposed to the secretions of high-risk animals—raccoons, bats, skunks, foxes, coyotes, dogs along the Mexican border, and wild carnivores in rabies-endemic areas.
- PEP given strictly according to WHO or CDC guidelines is extremely effective in preventing rabies. PEP includes wound care, passive immunization with RIG, and active immunization with rabies vaccine.
- Discussion with public health officials is recommended to guide decisions regarding when PEP should be considered.

## CHAPTER 123: QUESTIONS &amp; ANSWERS

**123.1.** Which of the following is the only US state or territory that is rabies-free?

- A. Alaska
- B. Hawaii
- C. Puerto Rico
- D. Vermont
- E. Washington, DC

**Answer: B.** There are no rabid bats or terrestrial mammals in Hawaii.

**123.2.** What domestic animal in the United States is most frequently reported as rabid?

- A. Cat
- B. Dog
- C. Ferret
- D. Gerbil
- E. Monkey

**Answer: A.** Cats account for the largest number of domestic rabies cases in the United States. The median age of rabid cats and dogs is 1 year. Most human cases in the United States are from bats.

**123.3.** Which of the following statements concerning human rabies is true?

- A. Encephalitic rabies is the most common form.
- B. Humans with impaired immunity are more likely to have encephalitis.
- C. It has a predilection for the neuromuscular junction.
- D. Most cases present with paralysis.
- E. The incubation period is independent of bite site.

**Answer: A.** Of human rabies cases, 80% are of the encephalitic (furious) form. Symptoms start as mild, with headache, fever, and paresthesia at the site of the bite, but rapidly progress over days to agitation, hypersalivation, hydrophobia, aerophobia, seizure, coma, and death.

**123.4.** An 18-year-old man presents with lower extremity weakness of 2 days' duration. He has no past medical history and takes no medication. Which of the following factors would help differentiate Guillain-Barré syndrome from paralytic rabies?

- A. Ascending pattern
- B. Cranial nerve dysfunction
- C. Diminished vision
- D. Fever
- E. Loss of deep tendon reflexes

**Answer: D.** Persistent fever from the onset of weakness, bladder dysfunction, and percussion myoedema suggest rabies. Preservation of sensory function is more likely with rabies.

**123.5.** Worldwide, which species is the dominant reservoir for rabies?

- A. Bats
- B. Dogs
- C. Foxes
- D. Raccoons
- E. Skunks

**Answer: B.** Worldwide, dogs remain the largest reservoir, the most commonly infected, and the leading vector for human rabies. Dogs are the most common cause of rabies in Asia and Africa where the vast majority of cases occur.

**123.6.** Postexposure care in a case of suspected rabies transmission should include which of the following?

- A. B, C, and E
- B. Active immunization
- C. Immediate suturing of all wounds
- D. Passive immunization
- E. Vigorous soap and water scrubbing and then virucidal flushing

**Answer: A.** Aggressive wound cleansing may be the most important action in the rabies prophylaxis. Vigorous soap and water scrubbing and flushing should be followed by copious application of a virucidal agent, such as benzalkonium chloride or povidone-iodine. Passive immunization with RIG and active immunization with an approved World Health Organization vaccine should quickly follow. Wounds should initially be left open, with a planned delayed closure when appropriate.

**123.7.** Which of the following statements regarding the administration of human rabies immune globulin (HRIG) and human diploid cell vaccine (HDCV) is true?

- A. HRIG and HDCV may be given at the same site.
- B. HRIG may be given at any time after the vaccine is administered.
- C. Postexposure prophylaxis is active only.
- D. Prophylaxis does not change in a pregnant patient.
- E. The gluteal region is the preferred vaccination site.

**Answer: D.** No protocol changes are indicated in pregnant patients. The deltoid is the preferred HDCV site to avoid injections into an area of more fat with less antibody production. It is critical that active and passive immunization occur. As much of the HRIG as possible should be infiltrated into the wound and the rest injected at a distant site. The immune globulin and vaccine should be injected at different sites. A typical plan is to inject HRIG into the wound, with the balance in one deltoid, and the vaccine administered into the opposite deltoid.

**123.8.** A 32-year-old emergency medicine intern crawls into bed after a 24-hour shift in the medical intensive care unit. Her 36-week pregnant spouse and 18-month-old daughter are asleep as she climbs into their bed. She is awakened from a dead sleep 3 hours later when her wife asks, "What is that brown thing on the ceiling?" Using a tennis racket, the bat is successfully encouraged out of the window. The intern calls you and asks if they need to be vaccinated. Your recommendations should include which of the following?

- A. PEP (postexposure prophylaxis) is contraindicated in the pregnant spouse.
- B. The 18-month-old and intern need PEP.
- C. The spouse needs PEP.
- D. They need better screens on their windows.



**Answer: B.** In spite of little evidence for a bite or scratch, the intern and 18-month-old fulfill requirements for PEP. Per Centers for Disease Control and Prevention recommendations, based on developmental staging, the 18-month-old girl cannot know whether an exposure may have happened. The intern does not explicitly meet the requirements for PEP because she is not a child, developmentally challenged, or intoxicated but, after a 24-hour shift, she was likely in a state of deep sleep and would not have been aware of her surroundings. Initiating PEP for her should be seriously considered. Although there is no contraindication for PEP during pregnancy, at 36 weeks, her spouse probably was not sleeping well and was certainly more aware of her surroundings than the intern. PEP should be considered for her but, if she is adamant that no bite or scratch occurred, it may be held.

**123.9.** A 3-year-old presents with a dog bite to the face. He was playing at his uncle's house in Oregon and grabbed the tail of the family dachshund while the dog was eating. The dog turned and bit him on the face. The dog is fully vaccinated. The parents are very concerned about the risk of rabies. You explain that all the below are true except which of the following?

- A.** Dog bites in the United States carry a very low risk for rabies.
- B.** Effective canine rabies vaccine in the United States has existed since 1947, so only dogs in the border towns at the border between the United States and Mexico are at risk.
- D.** Immediate immunization with human rabies immune globulin (HRIG) and rabies vaccine should be initiated.
- C.** Wound care appropriate for a dog bite is the recommended management.

**Answer: D.** Domesticated antagonized dogs carry a very low risk of rabies infection, but may bite when irritated by a small child. Simple wound management is indicated.

## KEY CONCEPTS

- HIV/AIDS can affect any organ system, and the nonspecific complaints seen with viral illness are common. Consider acute HIV infection in the evaluation of patients with mononucleosis-like syndromes in the presence of risk factors.
- The presenting illness may originate from acute HIV infection, opportunistic infections, medication side effects, inflammation, and IRIS.
- Patients with CD4<sup>+</sup> count above 500 cells/ $\mu$ L tend to have illnesses similar to those of individuals without HIV infection.
- Opportunistic infections are more frequent as the CD4<sup>+</sup> count declines but can occur at any stage of HIV infection.
- Formulation of the differential diagnosis should be guided by the patient's immune status—consider CD4<sup>+</sup> count, viral load, current medications, and prior opportunistic infections.
- Patients with HIV infection are at a greater risk of morbidity and mortality from common disease entities than noninfected patients.
- Patients with advanced AIDS suffer unusual diseases and often have multiple co-infecting pathogens.
- The current medications used for treatment of HIV infection (especially ART) can interact with many commonly prescribed drugs.

## CHAPTER 124: QUESTIONS &amp; ANSWERS

**124.1.** A 52-year-old man with acquired immunodeficiency syndrome (AIDS) presents with dysphagia. The pain radiates to his chest. He does not appear toxic. There is white plaque on his tongue and oropharynx, which is easily scraped off. His CD4<sup>+</sup> count was 52 cells/ $\mu$ L. He was just recently started on highly active antiretroviral therapy (HAART) and is taking atazanavir-ritonavir, tenofovir, and emtricitabine. What is the most appropriate treatment?

- A. Acyclovir
- B. Fluconazole
- C. Ganciclovir
- D. Immediate endoscopy
- E. Proton pump inhibitor

**Answer: C.** Odynophagia with a CD4<sup>+</sup> count less than 100 cells/ $\mu$ L and oral thrush suggests esophageal candidiasis. If the patient can tolerate oral therapy, fluconazole is first-line treatment. Endoscopy is reserved for treatment failure or those with an atypical presentation. Cytomegalovirus and herpes simplex virus can cause esophagitis but are less common. They are diagnosed with endoscopy, often after treatment failure with fluconazole. Patients with HIV can have esophagitis due to reflux but, in this setting, empirical treatment for candidiasis is the most appropriate. Proton pump inhibitors can decrease the absorption of atazanavir and should not be prescribed without first discussing the case with the patient's human immunodeficiency (HIV) physician.

**124.2.** Which of the following is not an AIDS-defining condition?

- A. Cellulitis
- B. Extrapulmonary *Cryptococcus*
- C. Invasive cervical cancer
- D. Recurrent pneumonia
- E. *Salmonella* septicemia

**Answer: A.** All the answers except A are AIDS-defining conditions.

**124.3.** A 52-year-old male patient presents with 3 days of confusion, fever, and headache. He was diagnosed with HIV 3 weeks ago and is not currently taking antiretroviral medications. His CD4<sup>+</sup> count at that time was 32 cells/ $\mu$ L. He has lived in the United States all his life. A head CT scan with contrast on this visit reveals multiple ring-enhancing lesions. Which of the following is the most likely cause of this central nervous system (CNS) lesion?

- A. Cytomegalovirus encephalitis
- B. HIV encephalopathy
- C. *Mycobacterium tuberculosis*
- D. Progressive multifocal leukoencephalopathy
- E. *Toxoplasma gondii*

**Answer: E.** *Toxoplasma* encephalitis presents over days to weeks with fever, headache, altered mental status, focal neurologic findings, and/or seizures. In 90% of cases, there are ring-enhancing CNS lesions. The CD4<sup>+</sup> count is typically less than 100 cells/ $\mu$ L, and often the count is much lower. The main differential diagnosis in developed countries is CNS lymphoma. Patients with ring-enhancing CNS lesions are often empirically treated for *Toxoplasma*, and then a repeat CT scan is performed. A brain biopsy is diagnostic. Tuberculoma must be considered in patients with an exposure to tuberculosis and in those who live in areas highly endemic for tuberculosis.

**124.4.** A 36-year-old woman presents with a warm, red, painful lower leg. She has multiple other dermatologic concerns, including flesh-colored, dome-shaped lesions on her face, a new dark pigmented lesion on her arm, cold sores, and facial erythema. Which of her cutaneous findings suggests HIV disease?

- A. Cellulitis
- B. Facial molluscum
- C. Melanoma
- D. Oral herpes
- E. Rosacea

**Answer: B.** HIV has many cutaneous manifestations. In this case, her facial molluscum is highly suggestive of HIV disease.

**124.5.** A 35-year-old man with AIDS presents with fever and a productive cough for 1 day. His last known CD4<sup>+</sup> count 1 month ago was 538 cells/ $\mu$ L. He has a lobar pneumonia in the left lower lobe on his chest radiograph. There is no evidence of lymphadenopathy. What is the most likely culprit pathogen in this case?

- A. *Cryptococcus neoformans* pneumonia
- B. Disseminated *Mycobacterium avium* complex
- C. *Pneumocystis jiroveci* pneumonia (PCP)
- D. Pulmonary tuberculosis
- E. *Streptococcus pneumoniae*

**Answer: E.** It is critical to have an understanding of diseases relative to the absolute CD4<sup>+</sup> T cell count. Patients with CD4 counts higher than 500 cells/ $\mu$ L typically develop illnesses similar to the general population. This patient presents with a lobar pneumonia, and *S. pneumoniae* is the most common cause. PCP is the most common opportunistic pathogen in AIDS patients, usually occurring in those with a CD4<sup>+</sup> T cell count lower than 200 cells/ $\mu$ L. It would be extremely unusual for PCP to cause a lobar pneumonia in someone who is immune-reconstituted. Tuberculosis can occur at any stage of HIV infection. However, the symptoms tend to be more gradual in onset, and a lobar pneumonia is unlikely.

## KEY CONCEPTS

- Parasitic diseases may manifest with almost any symptom or constellation of signs and symptoms. Accordingly, a travel history should be obtained from all patients with clinically significant signs and symptoms of unclear cause. The combination of presenting signs and symptoms and a history of recent travel to specific geographic regions can lead to early diagnosis and the initiation of pharmacotherapy, decreasing morbidity and mortality and increasing the probability of eradication of the infection.
- Parasitic coinfections are particularly common in patients with HIV infection and AIDS. A travel history is essential because the clinical presentation may be atypical, morbidity and mortality are more severe, and treatment and eradication of the parasite are often prolonged.
- Acute malaria should be suspected in patients with irregular high fevers associated with headache, abdominal pain, or respiratory symptoms. *Falciparum* malaria, which has a unique morphology easily identifiable on the peripheral blood smear, is the only species of malaria that causes coma and death. Furthermore, it is the most highly resistant to chemotherapy, demanding close observation and clinical follow-up of patients. Patients who are clinically ill or who are suspected of having *falciparum* malaria should be hospitalized for evaluation and treatment.
- Cysticercosis should be considered in the differential diagnosis for new-onset seizures, especially in immigrants from Central and South America.
- Giardiasis should be suspected in patients with diarrhea who have recently been camping or drinking unfiltered mountain spring water. Patients may have tolerated several weeks of severe bloating, flatulence, eructation, and weight loss without fever before seeking medical attention.

## CHAPTER 125: QUESTIONS &amp; ANSWERS

- 125.1.** A 33-year-old man presents with irregular fevers, shaking chills, intermittent abdominal pain, and fatigue. The fever comes in cycles during approximately 2 or 3 days. He has no medical history and takes no medications. He works as a baggage handler in Miami, Florida. Physical examination reveals a low-grade fever and mildly tender hepatosplenomegaly. Laboratory evaluation is remarkable for hemoglobin 9.6 g/dL, leukocytosis, lactate dehydrogenase 1850 IU/dL, elevated bilirubin, and urine dipstick “blood positive” but no red blood cells or white blood cells. He has had no international travel. Peripheral smear reveals few possible parasites with fragmented red blood cells. What is this patient’s most likely infection?
- Babesiosis
  - Early sepsis
  - Leishmaniasis
  - Lyme disease
  - Malaria

**Answer: E.** Airport malaria has been reported in people who have never been in endemic areas but who work in or live near an international airport. The infected mosquito is transported from the endemic region and released when the plane arrives. Babesiosis is a parasitic illness with a clinical picture like that of malaria. It is tickborne and is endemic in the northeastern United States.

- 125.2.** A 21-year-old Hispanic male immigrant presents with new onset of seizures. Paramedics report a right upper extremity focused seizure with loss of consciousness and postictal period of approximately 20 minutes. He has had no previous seizures, symptoms, medications, trauma, or ingestions. Laboratory examination is normal except for  $\text{HCO}_3^-$  17 mmol/L. Which of the following statements regarding the most likely cause of this patient’s seizures is TRUE?
- A ring-enhancing lesion suggests HIV infection.
  - Albendazole may be effective.
  - Contaminated beef ingestion should be suspected.
  - The stool examination will likely be negative.
  - There is no role for corticosteroids.

**Answer: B.** *Taenia solium* infection (cysticercosis) results from contaminated pork ingestion. The larvae penetrate the small intestine and may travel anywhere, with brain, muscle, and soft tissue being the likely areas of cyst occurrence with accompanying inflammatory reaction. The enlarging cyst (often a ring-enhancing lesion) causes the symptoms. Stool examination is diagnostic. Albendazole and corticosteroids are indicated for the central nervous system lesion. Postseizure acidosis is common and generally clears within 1 hour.

- 125.3.** Fever, headaches, and posterior cervical adenopathy in a recent African traveler should suggest which of the following?
- Central nervous system amebiasis
  - Cysticercosis
  - Falciparum* malaria
  - Schistosomiasis
  - Trypanosomiasis

**Answer: E.** Trypanosomiasis causes central nervous system inflammation and headache that may progress to psychiatric symptoms, lethargy, and coma. The posterior cervical adenopathy in this scenario is called Winterbottom’s sign.

- 125.4.** A macrocytic anemia would suggest infection from which parasite?
- Ancylostoma duodenale*
  - Diphyllobothrium latum*
  - Falciparum* malaria
  - Necator americanus*
  - Whipworm

**Answer: B.** The fish tapeworm is associated with pernicious anemia. Hookworm and whipworm are associated with gastrointestinal iron loss and microcytic anemia. Malaria causes hemolytic anemia.

- 125.5.** A 42-year-old man from Ethiopia presents with complaints of skin nodules and skin ulcerations. He has no known past illnesses, exposures, medication use, or systemic symptoms. Examination is remarkable for four 2- or 3-cm cutaneous ulcers on the arms and legs and scattered 1-cm nodules. Vital signs are normal, and physical examination is otherwise unrevealing. Which of the following statements regarding this infection is TRUE?
- Respiratory tract symptoms would suggest an alternative diagnosis.
  - The lesions always require treatment.
  - The lesions are likely painful to touch.
  - The skin pattern may be confused with leprosy.
  - This infection does not affect mucocutaneous areas.

**Answer: D.** Leishmaniasis is transmitted by the sandfly bite. Skin papules and macules develop at bite sites. These may ulcerate into painless ulcers. A microcutaneous variant may be seen, and the inflammatory process may involve the larynx and trachea. Disseminated cutaneous leishmaniasis may resemble lepromatous leprosy.

- 125.6. Parasite-induced loss of vision would be suggested by which of the following?
- A. Cardiomegaly
  - B. Edematous and pruritic skin
  - C. Fever
  - D. Hepatosplenomegaly
  - E. Iron deficiency anemia

**Answer: B.** Onchocerciasis is a major cause of blindness world wide. Ninety-five percent of cases occur in Africa. The biting flies are found near rivers, and humans are the only host for the parasite. It occupies the skin, resulting in pruritus, edema, and later atrophy with redundant skin folds. The following are other causes of parasite-induced visual loss: *Toxoplasma* can cause retinal hemorrhages, *Toxocara* can cause inflammatory retinal granulomas, and *Acanthamoeba* may cause a keratitis in contact lens wearers.

- 125.7. Which of the following is the correct association between the type of parasitic infection and pulmonary symptoms?
- A. Hookworm—positive PPD response
  - B. Leishmaniasis—pulmonary nodules
  - C. Löffler's syndrome—ascariasis
  - D. Pneumocystis—90% of opportunistic infections in Africa
  - E. Whipworm—anaphylaxis

**Answer: C.** Ascariasis and hookworm may cause Löffler's syndrome of chest pain, fever, rales, wheezing, and eosinophilia. The following are the other correct associations:

- Pneumocystis—less than 10% of pulmonary opportunistic infections in Africa
- Paragonimus westermani*—positive tuberculin skin test response and chest radiograph resembling tuberculosis
- Echinococcus—anaphylaxis from leakage of cystic contents
- Schistosomiasis—diffuse pulmonary nodules (Katayama fever)

- 125.8. Which of the following statements regarding AIDS and parasitic infections is TRUE?
- A. AIDS patients have more severe reactions to antiparasitic agents.
  - B. Diarrheal illness is reliably eradicable.
  - C. Invasive amebiasis is an opportunistic infection.
  - D. Malaria is an opportunistic infection.
  - E. Parasitic illnesses do not enhance the pathogenesis of HIV infection.

**Answer: A.** *Isospora* and coccidial organisms may cause an almost cholera-like diarrheal illness. Eradication is very difficult. Malaria and invasive amebiasis are not considered opportunistic infections. AIDS patients have much more severe allergic manifestations to the antiparasitics. Schistosomiasis enhances HIV pathogenesis.

- 125.9. A 34-year-old man presents with 2 weeks of fever with temperature of up to 102° F, anorexia, and 5-pound weight loss. He had recently been traveling in Central America in Belize, Nicaragua, and Guatemala. He had done some camping but mostly stayed in hostels. He never had nausea, vomiting, or diarrhea. His physical examination is noteworthy only for right upper quadrant tenderness and a palpable liver edge. He is not icteric or jaundiced and denies chalky stools or dark urine. He has a white blood cell count with a left shift. His transaminases are elevated, but otherwise his laboratory results are relatively normal. Stool examination for ova and parasites is negative. Hepatitis panel was sent but is still pending. What is the most likely diagnosis?

- A. *Entamoeba histolytica* infection
- B. *Fasciola hepatica* infection
- C. Hepatitis A
- D. Hepatitis B
- E. *Schistosoma mansoni* infection

**Answer: A.** *Entamoeba histolytica* infection with a hepatic abscess. *E. histolytica* can cause hepatic abscesses. Affected patients typically do not have amebic dysentery and do not shed *Entamoeba* in their stool, but results of serologic studies almost always are positive. Patients have fever, weight loss, anorexia, and right-sided abdominal pain but no jaundice. Treatment is with metronidazole or tinidazole and a luminal amebicide, such as iodoquinol.

- 125.10. A 26-year-old female medical student presents with a 3-month history of diarrhea and a 20-pound weight loss. She has not had fevers, chills, cough, headache, or rash. Four months ago, she had done a rotation in Nepal working at a rural health clinic associated with an American medical school. Toward the end of her rotation, she began to develop diffuse abdominal bloating and discomfort. This was accompanied by flatulence and intermittent watery diarrhea. She felt like she had swallowed a basketball and all of her pants were "too tight." "I thought I was pregnant, but my tests were all negative." She had lost her appetite and was very worried by the weight loss. The results of her laboratory tests, including complete blood count, Chem-20, and stool for ova and parasites, were negative. What is the most likely diagnosis?

- A. *Cryptosporidium parvum* or *Cyclospora cayetanensis* infection
- B. *Entamoeba histolytica* infection
- C. *Giardia lamblia* infection
- D. *Salmonella typhi* infection
- E. *Shigella dysenteriae* infection

**Answer: C.** *Giardia lamblia* can cause persistent diarrhea, abdominal bloating, cramps, flatulence, and significant weight loss. The organism is ingested and reproduces exponentially in the small bowel. In severe infection, the entire jejunum becomes covered with organisms, and the patient has malabsorption with steatorrhea. The organisms are rarely seen in fresh stool preparations because they quickly break down and become indiscernible. Accordingly, an antigen test often is used to confirm the diagnosis. *Giardia* has many animal reservoirs, including the beaver. Campers who drink unfiltered, pure mountain spring water in the United States commonly contract *Giardia* infection. Metronidazole, tinidazole, or nitazoxanide treats the disease.

- 125.11. A 64-year-old man recently emigrated from Laos is referred to the emergency department for fever, hemoptysis, anorexia, positive PPD response, and chest radiograph with several cavitory lesions. He had been started on a three-drug regimen for presumptive tuberculosis but seems to be getting worse. Several sputum samples had not grown out mycobacteria. He immigrated to the United States from Laos 6 months ago. He had lived in a rural district and worked farming rice before emigration. Through a translator, he reported having several bouts of pneumonia in the last year treated with antibiotics in Laos, but he never really got any better. He has had a persistent cough, which has gotten worse with recent hemoptysis. He has lost more than 20 pounds and appears cachectic and ill. Physical examination of the lungs reveals scattered rhonchi, rales, and wheezes. His complete blood count shows 12% eosinophils. What is the most likely diagnosis?
- A. Löffler's syndrome from *Ascaris lumbricoides* infection
  - B. Multiply drug resistant mycobacteria
  - C. *Paragonimus westermani* infection
  - D. *Pseudomonas pseudomallei* infection
  - E. Tropical eosinophilic pneumonitis from *Wuchereria bancrofti* infection

**Answer: C.** *Paragonimus westermani* is trophic for the lungs in their human hosts. If the human host consumes raw or under cooked shellfish, the metacercariae excyst within the host's duodenum, penetrating the duodenal wall into the abdominal cavity. The larvae migrate from the peritoneal cavity through the diaphragm into the pleural cavity, finally migrating to the lungs, where they cause hemorrhage, necrosis, and a granulomatous response. Early in the process, patients may have infiltrates and eosinophilia; later disease is marked by bronchiectasis, chronic bronchitis, fever, hemoptysis, and cachexia. Pulmonary nodules and cysts may cavitate. Many of these patients may have a positive result on purified protein derivative (PPD) testing, and their symptoms and chest radiographic findings may mimic tuberculosis. Sputum often is blood streaked and flecked with dark brown particles containing ova. Finding of ova in sputum is diagnostic. Radiography, stool examination, and immune testing of sputum and blood are all helpful in making the diagnosis. Praziquantel is the therapeutic agent of choice.



## KEY CONCEPTS

- Tickborne illnesses frequently are misdiagnosed as viral or bacterial infections. Early diagnosis can be facilitated by considering these diagnoses in patients who live in or recently have traveled to endemic areas and by routinely asking for a history of recent tick or insect bites in patients who present with febrile illnesses.
- Lyme disease should be suspected in patients who present with signs of a viral illness, monarticular arthritis, meningitis, multiple neurologic abnormalities, or heart block. Diagnosis can be confirmed with serologic testing of acute and convalescent serum samples. Normal physiologic changes from bites should not be confused with erythema migrans.
- Relapsing fever should be suspected in patients who present with recurrent viral-like illness associated with high fever. The diagnosis can be confirmed by the identification of spirochetes on a blood smear obtained during a period of rising temperature.
- Ulceroglandular tularemia should be suspected in patients with slow-healing extremity ulcers associated with large lesions of regional adenopathy (buboes). The diagnosis can be confirmed with serologic testing.
- RMSF should be considered in patients who present with an unexplained febrile illness, even in the absence of a rash or known tick exposure. Delayed diagnosis and late initiation of specific antirickettsial therapy may lead to a fatal outcome. Treatment never should be delayed pending laboratory diagnosis.

## CHAPTER 126: QUESTIONS &amp; ANSWERS

**126.1.** What is the most common vector-borne disease in the United States?

- A. Babesiosis
- B. Cysticercosis
- C. Lyme disease
- D. Malaria
- E. Tick paralysis

**Answer: C.** Lyme disease accounts for 95% of cases.

**126.2.** Which of the following statements regarding erythema migrans (EM) is true?

- A. The incidence with Lyme disease is 70%.
- B. The lesion center may become necrotic.
- C. The lesion is tender and warm to touch.
- D. The rash does not begin at the tick bite site.
- E. Satellite lesions do not occur.

**Answer: B.** EM occurs in 90% of cases. It begins at the bite site and expands. There may be central clearing, skip areas, central necrosis, vesicles, and marked erythema. It is warm but not tender. Satellite and secondary lesions may occur due to hematogenous seeding by spirochetes. They are smaller, nonmigratory, and spare the palms and soles. All lesions fade after approximately 1 month.

**126.3.** Which of the following clinical pictures is not seen with Lyme disease?

- A. Conjunctivitis
- B. Hepatitis
- C. Meningitis
- D. Pharyngitis
- E. Pleuritis

**Answer: E.** Clinical pictures consistent with hepatitis, conjunctivitis, pharyngitis, and meningitis may be seen with Lyme disease.

**126.4.** A 26-year-old woman presents complaining of muscle and joint aches. She has no past history and takes no medications except over-the-counter analgesics. She describes a pattern of migratory and intermittent muscle aches, which she reports as lasting only hours at any single location and then migrating. The physical examination reveals a mild pharyngitis and conjunctivitis and is otherwise normal. Which of the following statements is true?

- A. A history of tick bite should be sought.
- B. A rheumatoid factor (RF) level should be determined.
- C. An erythrocyte sedimentation rate (ESR) would be confirmatory.
- D. Creatine phosphokinase (CPK) levels are likely elevated.
- E. Fibromyalgia is likely.

**Answer: A.** The migratory, short-lived, and intermittent nature of the Lyme-related arthralgias is sometimes the best clue to the diagnosis. The ESR, RF, and CPK values will likely be normal. Both rheumatoid arthritis and fibromyalgia present with progressive and usually symmetrical symptoms. Conjunctivitis, pharyngitis, meningitis, and hepatitis pictures may be part of the Lyme presentation.

**126.5.** Which of the following statements concerning neurologic manifestations of Lyme disease is true?

- A. Bilateral Bell's palsy is suggestive of Lyme disease.
- B. Extremity involvement is symmetric.
- C. Reflexes are not lost.
- D. Spinal roots and plexi are spared.
- E. The most common cranial nerve affected is the third.

**Answer: A.** The seventh cranial nerve is most commonly affected. Bilateral Bell's palsy should suggest a possible Lyme diagnosis. Reflexes may be lost. Extremity involvement is usually asymmetric. Plexopathies, thoracic radiculopathies, mononeuritis, and motor radiculitis may all be seen.

**126.6.** Which of the following statements regarding Lyme carditis is true?

- A. Cardiac involvement is uncommon.
- B. Electrocardiographic changes are stable and persistent.
- C. Onset time from initial illness is 2 or 3 months.
- D. The most common manifestation is bundle branch block.
- E. Ventricular dysfunction is common and persistent.

**Answer: A.** Cardiac involvement is uncommon. The most common manifestation is atrioventricular block, which may fluctuate significantly but often resolves as the cardiac inflammation recedes. Onset time from illness is an average of 3 to 5 weeks. Ventricular dysfunction is not common, and the prognosis is good.

**126.7.** A 33-year-old woman presents with worsening depression, irritability, and hypersomnolence. She was diagnosed with Lyme disease 2 years prior and underwent a full course of antibiotics that was initiated 12 weeks after initial symptom onset. Her psychiatric issues began approximately 6 months ago. Her only medication is citalopram. The physical examination is remarkable for a depressed affect and poor short-term memory by bedside assessment. Which of the following statements is true?

- A. A demyelinating syndrome may occur after Lyme disease.
- B. Late cranial nerve involvement is not seen.
- C. Magnetic resonance imaging (MRI) scanning of the brain will be normal.
- D. Paranoia would imply a separate cause from Lyme disease.
- E. Peripheral neuropathy is the expected late finding in Lyme disease.

**Answer: A.** The most common late neurologic manifestation is an encephalopathy that may include memory impairment, learning issues, depression, and paranoia. A demyelinating multiple sclerosis–like picture with central nervous system plaques on MRI may be seen. Any portion of the nervous system, including cranial nerve dysfunction, may be seen.

**126.8.** A patient returns to the emergency department for follow-up of Lyme titers drawn 2 days earlier during an initial evaluation for ongoing arthralgias, myalgias, and history of a rash. The rash came and went approximately 10 weeks prior. Which of the following statements is true?

- A. Early antibiotic therapy will not abolish the antibody response.
- B. IgG (immunoglobulin G) antibody may persist for years after successful treatment.
- C. IgM (immunoglobulin M) positive and IgG negative suggest Lyme disease.
- D. IgM positive and IgG positive suggest Lyme disease.
- E. IgM becomes positive within 1 week of infection.

**Answer: B.** IgM may be negative early on but peaks at weeks 3 to 6. IgG may be detectable at 2 months. Early antibiotic therapy may blunt or abolish the antibody response. Thus, two windows of negative titers may be seen, very early and again in the second month, when IgM has waned and IgG has not risen. In patients with an illness longer than 1 month, an isolated IgM test is likely to be a false-positive and should not be used to support the diagnosis. IgM should have waned when IgG levels rise. Overall, acute and convalescent titers 1 month apart may be necessary for accurate diagnosis. IgG levels may persist for years; these levels are not diagnostic of ongoing infection and do not confer immunity.

**126.9.** A 26-year-old man presents with 2 weeks of headache, fever, and stiff neck during the summer months. Which of the following characteristics would best differentiate Lyme disease from enteroviral infection?

- A. Cerebrospinal fluid protein and glucose levels and cell count
- B. Enteroviral rash morphology
- C. Lyme IgM titer
- D. Presence of arthralgias
- E. Presence of diarrhea

**Answer: E.** Lyme disease most closely resembles reactive arthritis, with an asymmetric, oligoarticular, episodic picture. Eye and genital findings help differentiate, although 10% of Lyme disease patients may have conjunctivitis. Lyme disease and reactive arthritis have huge knee effusions, with a paucity of pain compared with effusion size in Lyme disease. Juvenile rheumatoid arthritis and Lyme disease have negative rheumatoid factor test results. Erythema marginatum occurs with the arthritis of rheumatic fever. Lyme disease patients may meet clinical Jones criteria for rheumatic fever but lack serologic evidence of streptococcal infection.

**126.10.** A 29-year-old pregnant female camper presents with concerns about a tick bite and Lyme disease. She was camping in Connecticut 3 days ago and had several tick bites. The last tick was removed yesterday. What should you do?

- A. Administer azithromycin daily for 2 weeks.
- B. Counsel her about signs and symptoms of Lyme disease.
- C. Prescribe amoxicillin.
- D. Prescribe antiinflammatories.
- E. Prescribe outpatient intramuscular ceftriaxone.

**Answer: C.** Antibiotic prophylaxis is indicated in certain circumstances. Lyme disease may be transmitted transplacentally, so prophylaxis is likely indicated. Amoxicillin and macrolides are only first-line agents when doxycycline is contraindicated. Macrolides are third-line agents after doxycycline and amoxicillin.

## KEY CONCEPTS

- Early recognition of patients with risk for TB should begin at ED triage. Patients thought to have active pulmonary TB should be placed in respiratory isolation as soon as possible.
- TB should be considered in the differential diagnosis of patients who present with fever, cough, and weight loss.
- Risk factors for TB include HIV-infection, immunosuppression, age older than 60 years, foreign-born, homeless, and close contact with known cases.
- Beyond pulmonary manifestations, a variety of extrapulmonary manifestations may occur, including involvement of lymph nodes, pleura, bones, or joints and CNS, genitourinary, and gastrointestinal systems.
- Therapy should be determined based on consultation. The most commonly used agents are INH, RIF, PZA, and EMB. Resistant strains, including MDR-TB and XDR, have been increasing in frequency.

## CHAPTER 127: QUESTIONS &amp; ANSWERS

127.1. Which of the following is not a typical vehicle for tuberculosis transmission?

- A. Coughing
- B. Eating utensils
- C. Parenteral transmission
- D. Sneezing
- E. Talking

**Answer: B.** Bedclothes and eating utensils do not require special decontamination. Parenteral transmission is largely a risk of health care workers (eg, skin ulcers, draining wounds). Talking, coughing, and sneezing all may produce significant droplet spread.

127.2. Which of the following anatomic areas is not a site of preferential organism spread during stage 2 spread of TB?

- A. Kidneys
- B. Long bone epiphyses
- C. Lung bases
- D. Lymph nodes
- E. Meninges

**Answer: C.** Lung apices are favored rather than the bases. These sites are preferred, possibly because of high oxygen tension.

127.3. Clinically active TB develops in what percentage of immunocompetent purified protein derivative (PPD) converters?

- A. 1%
- B. 5%
- C. 10%
- D. 15%
- E. 20%

**Answer: C.** TB develops in 10%—3% to 5% in the first 2 years (acute primary) and 5% later in life (reactivation). Patients with HIV infection develop primary TB at a rate of 37% within 6 months and then develop active TB at a rate of 7% to 10%/year.

127.4. Which of the following statements regarding clinical tuberculosis is true?

- A. Exogenous reinfection after past TB gives a clinically distinct picture.
- B. Most clinical TB is from acute primary infection.
- C. Acute infection is usually asymptomatic.
- D. Most ED patients with pulmonary TB have pulmonary complaints.
- E. Large hilar nodes are most common in older adults.

**Answer: C.** Acute infection is very often asymptomatic or, at most, vague. Exogenous reinfection looks just like primary or reactivation TB. Most clinical TB is from reactivation of dormant foci. Many ED patients with active pulmonary TB have no pulmonary symptoms. Large hilar nodes are most common in infants and children.

127.5. Which of the following is a risk factor for reactivation of tuberculosis in a previously infected person?

- A. All of these
- B. Body weight more than 10% below ideal
- C. Diabetes
- D. Intestinal malabsorption syndrome
- E. Silicosis

**Answer: A.** Other risk factors are listed in [Box 127.2](#)

127.6. A 26-year-old man with HIV infection presents with chest pain and fever. The evaluation yields a likely diagnosis of pericarditis with effusion. What is the most likely cause?

- A. Cryptococcal infection
- B. *Haemophilus influenzae*
- C. Lymphoma
- D. *Streptococcus pneumoniae*
- E. Tuberculosis

**Answer: E.** Tuberculosis is the leading cause of pericarditis in HIV-infected individuals in the United States. The incidence is 15%.

127.7. Which of the following statements regarding chest radiography findings in pulmonary tuberculosis is true?

- A. Adenopathy may distinguish TB from bacterial pneumonia.
- B. Primary TB typically appears as an upper lobe cavity lesion.
- C. The false-negative rate is 10% in immunocompetent patients.
- D. The false-negative rate is 40% in HIV-infected patients.
- E. The typical TB infiltrate is heterogeneous and multilobed.

**Answer: A.** Hilar adenopathy may be the only way to suspect TB as opposed to a typical bacterial pneumonia. Primary TB is usually a single-lobe infiltrate with a homogeneous appearance. It is postprimary TB that has a predilection for the upper lobes, with or without cavitation. The false-negative rate for chest radiography in immunocompetent patients is very low, 1%. The rate increases to 7% to 15% in HIV-infected patients and those with endobronchial disease.

127.8. Which of the following statements regarding the radiographic appearance of tuberculosis and infectivity is true?

- A. Chronic fibrotic changes are unlikely to be infective.
- B. Normal radiographs are uncommon with HIV infection.
- C. Only the presence of adenopathy can determine active disease.

D. Patients with late HIV infection are less likely to have adenopathy.

E. The presence of cavitation implies high infectivity.

**Answer: E.** Cavitation suggests high infectivity. Chronic fibrotic changes cannot differentiate old versus active disease, and many of these patients will have positive sputum. Active disease can only be determined radiographically by serial radiographs. Patients with late HIV infection are more likely to have mediastinal adenopathy and less likely to show cavitations. Normal radiographs are common with HIV infection.

**127.9** What is the most common form of extrapulmonary tuberculosis?

A. Genitourinary

B. Lymphatic

C. Meningeal

D. Peripheral bone or joint

E. Vertebral

**Answer: B.** Lymphatic involvement (eg, scrofula) accounts for 42% of cases.

## KEY CONCEPTS

- Skeletal infection should be considered in the differential diagnosis of all patients who present with bone or joint pain.
- Hematologic evaluation is of little value in the diagnosis of bone and joint infections, with the exception of the ESR and CRP level, which are elevated in approximately 90% of cases of bone and joint infections.
- The diagnostic evaluation for septic arthritis includes complete blood count, ESR, and CRP level. Joint aspiration is the definitive diagnostic procedure, and synovial culture is the only reliable joint fluid test for establishing a diagnosis.
- The diagnosis of osteomyelitis involves an operative culture of the infected bone. MRI has become the best diagnostic modality to detect osteomyelitis.
- With suspected septic arthritis, joint fluid and blood culture specimens are obtained before IV antibiotics are administered. With suspected osteomyelitis, blood culture specimens are obtained, and IV antibiotics are administered while plans are made for further imaging studies or surgical aspiration or resection of bone.
- The most important aspect of antibiotic treatment of suspected bone and joint infections is to provide potent bactericidal activity against *S. aureus* with additional empirical antibiotic coverage aimed at suspected organisms on the basis of age, risk factors, and regional variability.

## CHAPTER 128: QUESTIONS &amp; ANSWERS

- 128.1.** Which of the following statements regarding osteomyelitis is true?
- Contiguous focus osteomyelitis is most common in the knee.
  - Hematogenous osteomyelitis begins in medullary bone.
  - Head and neck osteomyelitis is usually from hematogenous spread.
  - Septic arthritis begins in joint fluid and spreads to synovium.
  - Septic arthritis morbidity is related to joint size.

**Answer: B.** Hematogenous osteomyelitis begins in medullary bone and spreads outward. Contiguous focus osteomyelitis, most common in the foot and hand, begins outside of bone and spreads inward via Volkmann's canal. Head and neck osteomyelitis is usually from a contiguous sinus or otic process. Septic arthritis begins in synovium and later involves joint fluid. Morbidity is related to the degree of hyaline cartilage destruction.

- 128.2.** Which of the following associations between osteomyelitis and pathogenic organism is true?
- Dog bite—*Pasteurella*
  - Freshwater wounds—*Pseudomonas*
  - Human bite—*Aeromonas*
  - Intravenous drug use—*Fusobacterium*
  - Sickle cell anemia—*Haemophilus influenzae*

**Answer: A.** The following are correct associations:  
 Freshwater—*Aeromonas hydrophila*  
 Intravenous drug use (IVDU)—*Staphylococcus aureus*  
 Sickle cell—*Pseudomonas* and *Salmonella*  
 Cat or dog bite—*Pasteurella multocida*  
 Human bite—mixed with *Fusobacterium*, *Eikenella*, and *Streptococcus anginosus*

- 128.3.** Which of the following statements regarding septic arthritis is true?
- Despite vaccination, *Haemophilus influenzae* remains a frequent pathogen in children.
  - Pseudomonas aeruginosa* is associated with IVDU-related osteomyelitis.
  - Pseudomonas aeruginosa* is not associated with prosthetic device joint infection.
  - The most common organism in neonates is *Staphylococcus aureus*.
  - The most common organism in patients younger than 30 years is *S. aureus*.

**Answer: B.** *Pseudomonas* is associated with IVDU-related cervical osteomyelitis and lumbar osteomyelitis in cases of prolonged urinary catheterization. *H. influenzae* has largely disappeared as a joint pathogen in vaccinated children. The most common neonatal joint pathogens are group B streptococci, *Escherichia coli*, and *Staphylococcus epidermidis*. The most common cause of septic arthritis in people younger than 30 years is gonococcal.

- 128.4.** Which of the following statements regarding acute hematogenous osteomyelitis in children is true?
- Blood cultures are not usually positive.
  - Skeletal scintigraphy is indicated in neonates.
  - The child usually appears toxic.
  - The most common site is the long bone epiphysis.
  - There is a female preponderance.

**Answer: C.** Children may be ill but not usually toxic. There is a 2:1 or 3:1 male predominance, with the most likely site being the distal metaphysis. Blood cultures are positive in 60% of cases. Scintigraphy is not useful in neonates due to a limited inflammatory response. Radiographs are more useful and sensitive early on than in adults.



**128.5.** Which of the following statements regarding vertebral osteomyelitis is true?

- A. Children are less prone to isolated diskitis.
- B. Of the cases of epidural abscesses, 30% are due to osteomyelitis.
- C. The diagnostic procedure of choice is a magnetic resonance imaging scan.
- D. The most common location is the lumbar spine.
- E. Vertebral osteomyelitis typically involves a single vertebra.

**Answer: D.** The incidence of associated epidural abscess is 15%. The most common location of vertebral osteomyelitis is the thoracic, lumbar, and cervical spine. The diagnostic procedure of choice is needle biopsy. The disease usually involves two vertebrae and the disk in between. Children are more prone to isolated diskitis, although it may also occur in adults.

**128.6.** An 18-year-old woman with known sickle cell disease presents with leg pain of 2 days' duration. Her typical pain syndrome is lower extremity tibial and femur pain. Today's episode is primarily right tibial. She complains bitterly of pain, but there are no gross findings other than trace bilateral anterior tibial swelling, with no discernible warmth or erythema. Vital signs are remarkable for a low-grade fever and heart rate of 110 beats/min. Which of the following statements regarding this patient's condition is true?

- A. Bony infection would be expected in the bony diaphysis.
- B. Plain radiography can differentiate bony infarction from infection.
- C. *Salmonella* would be the most likely infectious cause.
- D. Technetium scintigraphy (bone scanning) will differentiate infection from infarction.

E. The erythrocyte sedimentation rate (ESR) is elevated in sickle pain crises.

**Answer: A.** Sickle cell osteomyelitis is more typically seen in the diaphysis than in non-sickle cell situations, which more often involve the metaphysis. Fever, toxicity, and an elevated ESR suggest infection. The most likely infectious cause is still *Staphylococcus aureus*, followed by *Salmonella*. Often, observation and response to therapy (eg, analgesics, hydration) ultimately help differentiate the two. Plain technetium lights up infection and infarction. Indium or gallium is necessary to show a hot spot of infection; an infarctive site would be cold.

**128.7.** Which test will most likely confirm a diagnosis of gonococcal arthritis in a female?

- A. Pelvic culture
- B. Serum gonococcal culture
- C. Synovial gonococcal culture done on chocolate agar
- D. Thorough history

**Answer: A.** It is recommended that cervical culture be used to confirm the likely presence of GC arthritis.

**128.8.** When should antibiotics be administered in cases of suspected septic arthritis?

- A. After radiographic confirmation of the diagnosis
- B. After serologic confirmation of the diagnosis
- C. After synovial fluid is sent for culture
- D. After synovial Gram staining comes back positive

**Answer: C.** To guide effective antibiotic therapy, it is recommended to withhold antibiotics until synovial fluid has been obtained.

## KEY CONCEPTS

- Skin infections are common and are rarely life-threatening. Deadly necrotizing skin and soft tissue infections are rare, and there is insufficient evidence to motivate screening by laboratory tests.
- Necrotizing infection is suggested by pain out of proportion to physical findings, crepitance, gas seen on imaging studies, or clinical instability. Suspected necrotizing infection is managed aggressively, with broad-spectrum antibiotics, critical care resuscitation, and surgical consultation.
- Emergency clinicians should be familiar with toxic shock syndromes and Rocky Mountain spotted fever, which are rare, life-threatening, skin infection–related syndromes. Lyme disease should be considered in endemic areas.
- For the management of most skin abscesses, antibiotics are not recommended. Adequate analgesia or sedation are essential to good patient care. There is debate about the necessity of wound culture and Gram staining.
- Current recommendations for the treatment of cellulitis suggest agents effective against streptococci and methicillin-sensitive *Staphylococcus aureus* (eg, cephalexin at maximal doses). Adjunctive measures are essential to a good treatment response—NSAIDs, immobilization, elevation, and compression.
- Clindamycin monotherapy is an excellent choice for the treatment of skin infections because it covers streptococci and most staphylococci, including most CA-MRSA isolates.
- Although they are active against CA-MRSA, trimethoprim-sulfamethoxazole and tetracyclines may not be effective for streptococci and are not recommended for cellulitis monotherapy.
- There is insufficient evidence to recommend measurement of the white blood cell count in patients with skin infections.
- Blood cultures are not necessary for the evaluation of skin infections, except with septic shock, necrotizing infections, immunocompromise, multifocal infections suggesting hematogenous seeding, infections complicating lymphedema, and perhaps facial cellulitis.
- Skin infection mimics include venous stasis dermatitis and other forms of dermatitis.

## CHAPTER 129: QUESTIONS &amp; ANSWERS

- 129.1.** Which of the following statements regarding cellulitis is true?
- A. Bilateral cellulitis of the lower extremities is a common bacterial infection.
  - B. Computed tomography (CT) can rule out necrotizing fasciitis.
  - C. Fever and leukocytosis are key to the diagnosis.
  - D. Needle aspiration of the leading edge is unlikely to identify the causative organism.
  - E. Ultrasound evaluation cannot rule out a large abscess.

**Answer: D.** Needle aspiration and even biopsy are rarely able to identify a causative organism in nonpurulent cellulitis. Fever and leukocytosis are often absent, and measurement of the white blood cell count is not indicated. Ultrasound evaluation is sensitive and specific and can rule out a large abscess, although distinguishing small abscesses from the cobblestoning of cellulitis can be difficult. Bilateral lower extremity inflammation is usually venous stasis dermatitis, which can be confused with cellulitis. Bilateral cellulitis is rare and suggests hematogenous dissemination.

- 129.2.** A 7-year-old girl presents with right periorbital pain and swelling. Physical examination reveals a temperature of 38° C (100.4° F), periorbital edema, erythema, and warmth. Some erythema and edema of the eyelids occur as well. Vision, extraocular movements, and pupils are normal. Which of the following statements regarding this patient's condition is true?
- A. An urgent CT scan is indicated.
  - B. Plain radiographs of the sinuses are indicated.
  - C. Progression to the other eye is likely.
  - D. Progression to vision loss is likely.
  - E. She should be treated as an outpatient with antibiotics targeting staphylococci.

**Answer: E.** Well-appearing children with no eye pain or pain on extraocular movement may be diagnosed with preseptal cellulitis and treated as outpatients if the parents can be trusted to return for failure to improve. Historically, *Haemophilus influenzae* type B was an important organism but, in vaccinated children, this is less likely; unvaccinated children should receive an agent effective against this organism. Orbital cellulitis is suggested by change in vision, eye pain, pain with extraocular movements, or a toxic appearance. When there is doubt, CT scanning is appropriate but not mandatory in all cases. Most cases are unilateral. Progression

to endophthalmitis and vision loss is not expected with preseptal cellulitis, although it can occur in orbital cellulitis.

- 129.3.** A 53-year-old woman presents with fever and painful swelling of the left side of her face. The physical examination is remarkable for a toxic-appearing woman with a sharply demarcated, raised, bright red, and extremely tender eruption involving the left side of her face. Which of the following statements regarding this patient's condition is true?
- A. Echocardiography is indicated.
  - B. Fluoroquinolones are first-line antibiotics.
  - C. Penicillin G monotherapy is the correct treatment.
  - D. The face is the most commonly involved site.
  - E. There is an association with glomerulonephritis.

**Answer: E.** Erysipelas is an acute cellulitis typically caused by group A streptococci. It presents with an angry red area of inflammation that is well-demarcated from the surrounding skin and has a raised border. Like other group A streptococcal skin infections, erysipelas can give rise to poststreptococcal glomerulonephritis. Penicillin G is probably the ideal therapy, but any toxic-appearing patient should be treated more aggressively, with goal-directed therapy and broad-spectrum antibiotic coverage. *H. influenzae* is a classic cause of facial cellulitis but is more common in children, is rare in the era of Hib vaccination, and typically causes transdermal cellulitis, rather than the more superficial form of cellulitis known as erysipelas. The lower extremities are usually involved.

- 129.4.** A 5-month-old girl presents with fever and a diffuse dermatitis characterized by bulla formation, with surrounding vesicles leading to the loss of large sheets of epidermis. She has no past medical history and has been on no medications. The areas of desquamation are tender and red. Which of the following statements regarding this patient's condition is true?
- A. Antibiotics are not indicated.
  - B. Corticosteroids will help prevent progression.
  - C. Culture of the bullae is not indicated.
  - D. Mortality is greater than 30%.
  - E. Mucous membranes are likely affected.

**Answer: C.** Staphylococcal scalded skin syndrome is a toxin-mediated process occurring in the very young (6 months–6 years) and older adults. The cornerstone of treatment is hydration and

antistaphylococcal antibiotics. Culture of bulla fluid is generally negative. Mucous membranes are spared. This condition is rarely fatal.

- 129.5.** A 7-year-old boy presents with a left leg rash. The mother describes an initial sequence of a patch of small red papules that rapidly became vesicular, then pustular, and then crusted over. You observe a 2- × 3-cm area on the left thigh, with heavily crusted erythematous macules. There is moderate left inguinal lymphadenopathy. The lesions are not tender, and the child is not toxic-appearing. Which of the following statements regarding this patient's condition is true?
- A. Acute rheumatic fever is a risk.
  - B. Corticosteroids are indicated.
  - C. Systemic antibiotics are necessary.
  - D. The streptozyme test is highly reliable.
  - E. Topical mupirocin is indicated.

**Answer: E.** Impetigo involves a blistering eruption with a honey-colored crust. It may be caused by streptococci or staphylococci. For limited disease, topical mupirocin is the treatment of choice. Oral or systemic antibiotics are only indicated for more severe cases. Corticosteroids are not indicated. No laboratory test is useful. Acute rheumatic fever does not occur after impetigo. Poststreptococcal glomerulonephritis may occur, but is less likely than after pharyngitis.

- 129.6.** Which of the following statements about skin infections in the age of community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is false?
- D. Abscesses should be treated with antibiotics active against CA-MRSA.
  - A. CA-MRSA is usually associated with mild disease.
  - E. Evidence is lacking that CA-MRSA plays a role in nonpurulent skin infections.
  - C. The cause of most cases of cellulitis is unknown.
  - B. There is no clinical trial evidence to support the use of trimethoprim-sulfamethoxazole for any skin infection.

**Answer: D.** Multiple trials have suggested that antibiotics are not beneficial when an abscess is treated with incision and drainage. Only extraordinarily large abscesses, multiple abscesses, and other special cases merit antibiotic treatment. When antibiotics are used, they should cover CA-MRSA. Most cases of CA-MRSA disease are mild, purulent, skin infections. So far, no clinical trial has demonstrated benefit of trimethoprim-sulfamethoxazole for the treatment of any skin infection. The cause of nonpurulent cellulitis is usually impossible to ascertain because even biopsy rarely yields a positive culture. There is insufficient evidence that CA-MRSA is an important pathogen in nonpurulent cellulitis to justify the use of anti-CA-MRSA antibiotics in its treatment.

- 129.7.** A young woman presents complaining of a painful itchy rash. She has just returned from a vacation in the Caribbean, where she was snorkeling. Examination reveals streaks of erythema with slight vesiculation along the lateral aspect of the right leg. The lesions are oriented diagonally, not along vascular lines, and are about 15 cm long. What is the most appropriate next step in this patient's management?
- A. Obtain a CT scan to assess for necrotizing fasciitis.
  - B. Perform a Tzanck smear performed on an unroofed vesicle.
  - C. Treat with acyclovir.
  - D. Treat with corticosteroids.
  - E. Treat with trimethoprim-sulfamethoxazole.

**Answer: D.** This is an example of contact dermatitis, likely from seaweed or jellyfish stings. Nothing in the presentation is suggestive of an infection. Trimethoprim-sulfamethoxazole monotherapy is rarely appropriate because abscesses generally do not require antibiotics, and streptococci are thought to be covered poorly by this antibiotic. A Tzanck smear and acyclovir treatment would be appropriate if herpetic infection were suspected, but neither herpes simplex nor varicella zoster would present with 15-cm streaks.

## KEY CONCEPTS

- Sepsis is a progression of disease due to a dysregulated inflammatory cascade, leading to organ dysfunction and circulatory compromise in severe cases.
- Sepsis is subtle and often difficult to detect, so the emergency clinician should maintain a high index of suspicion when assessing patients in the ED.
- Older adults, immunocompromised and neutropenic patients, and patients with multiple comorbidities are at increased risk for the development of sepsis syndromes.
- A thorough history and physical examination should guide the diagnostic evaluation.
- Early treatment should focus on appropriate identification, improvement of tissue perfusion (through administration of fluids and vasopressor medications), improvement of tissue oxygenation (through administration of oxygen and positive-pressure ventilation), administration of antibiotics, and early identification of infections requiring surgical management.
- Prompt administration of antibiotics is essential and should be based on the suspected source of infection.

## CHAPTER 130: QUESTIONS &amp; ANSWERS

- 130.1.** Which of the following patients meets the criteria for systemic inflammatory response syndrome (SIRS)?
- 6-year-old boy with pneumonia, temperature 39.0° C (102.2° F)
  - 21-year-old woman with abdominal pain, temperature 38.3° C (100.9° F)
  - 53-year-old man with respirations, 30 breaths/min, white blood cell (WBC) count, 16,000 cells/mm<sup>3</sup>
  - 74-year-old woman with chest pain, heart rate 130 beats/min
  - 81-year-old man with WBC count, 2700 cells/mm<sup>3</sup>, heart rate, 73 beats/min

**Answer: C.** SIRS is defined as two or more of the following—tachycardia, tachypnea, temperature higher than 38° C (100.4° F) or lower than 35° C (95° F), high or low WBC count, or bandemia. Sepsis is SIRS with infection. Severe sepsis includes organ dysfunction. Septic shock involves systolic blood pressure below 90 mm Hg.

- 130.2.** Sepsis is characterized by which of the following?
- Depression of arachidonic acid metabolites
  - Depression of tumor necrosis factor levels
  - Increased endogenous anticoagulant levels
  - Prolonged suppression of nitric oxide levels
  - Prolonged suppression of vasopressin levels

**Answer: E.** Clinical sepsis is induced by sustained levels of proinflammatory and procoagulant mediators. Cytokines (interleukin-1, interleukin-6, and tumor necrosis factor alpha) and prostaglandins are primary mediators. Nitric oxide synthase is upregulated, resulting in sustained elevations of the serum nitric oxide level, with subsequent vasodilations. Sustained suppression of vasopressin adds to this sometimes refractory vasodilated state.

- 130.3.** Which of the following statements regarding septic shock is true?
- Cardiac output is always decreased.
  - Much of the cardiac decompensation is reversible.
  - Systemic vascular resistance is high.
  - The ejection fraction is always increased.
  - Ventricular dilation is unusual.

**Answer: B.** Sepsis affects myocardial function and peripheral vascular tone. The systemic vascular resistance is usually markedly depressed. Cardiac output is generally increased because of a compensatory tachycardia that can at least partially overcome the ventricular dilation and depressed ejection fraction. The myocardial effects are typically reversible.

- 130.4.** What are the two most common sources of infection in cases of sepsis?
- Genitourinary > respiratory
  - Musculoskeletal > genitourinary
  - Respiratory > gastrointestinal
  - Respiratory > genitourinary
  - Skin > respiratory

**Answer: C.** Epidemiology studies show that pneumonia is the most common cause of sepsis, followed by an intra-abdominal source. However, a careful investigation to identify the source of infection should occur.

- 130.5.** In most chemotherapy patients, which neutrophil count should prompt admission, isolation, and empirical antibiotics?
- <250 cells/mm<sup>3</sup>
  - <500 cells/mm<sup>3</sup>
  - <750 cells/mm<sup>3</sup>
  - <1000 cells/mm<sup>3</sup>
  - <2000 cells/mm<sup>3</sup>

**Answer: B.** Patients with an ANC <500 cells/mm<sup>3</sup> are at increased risk of infection; thus, a conservative approach should be taken in these patients.

- 130.6.** Among patients with clinical septic shock, which percentage will have positive blood cultures?
- 0%–30%
  - 30%–60%
  - 60%–90%
  - 90%–100%
  - Varies according to patient comorbidities

**Answer: B.** While blood cultures are perhaps a gold standard for identification and isolation of bacteria, they may be negative, even when the etiology of illness is clearly infectious. Empiric antibiotic treatment in the ED remains a standard approach.

- 130.7.** A 65-year-old man presents with blood pressure of 88/40 mm Hg, heart rate of 105 beats/min, respiratory rate of 24 breaths/min, O<sub>2</sub> saturation of 92%, and temperature of 38.5° C (101.3° F). Fluid resuscitation, oxygen, and empirical antibiotics are begun. Blood pressure after 2 L of saline is 98/50 mm Hg. A central venous catheter is placed, with a central venous pressure of 11 mm Hg. A venous blood gas sample drawn from this catheter shows hematocrit of 24%, Po<sub>2</sub> of 34 mm Hg, Pco<sub>2</sub> of 46 mm Hg, pH of 7.29, and O<sub>2</sub> saturation of

63%. O<sub>2</sub> saturation by pulse oximeter is now 96%. What is the most appropriate next step according to the early goal-directed therapy protocol?

- A. Dopamine, 10 µg/kg/min
- B. Endotracheal intubation
- C. Packed red blood cell transfusion
- D. Phenylephrine, 50 µg/min
- E. Saline 0.9%, 2 L more

**Answer: C.** For the optimal management of sepsis, central venous pressure monitoring (ideally with oximetric capabilities) and mixed venous blood gas monitoring are indicated. This patient

meets criteria for septic shock. Intermittent central venous (eg, mixed) blood gas analysis is likely to be adequate. Therapeutic targets are a central venous pressure of 8 to 12 mm Hg in the nonintubated patient and a mixed venous O<sub>2</sub> saturation of 70% (review of the oxyhemoglobin desaturation curve reminds us that 75% is normal). After volume resuscitation, this patient still had a low mixed venous saturation, indicating inadequate peripheral oxygen delivery and increased extraction by the tissues. With O<sub>2</sub> saturation nearly normal (96%), the only way to increase oxygen delivery is by red blood cell transfusion to increase the plasma hemoglobin concentration.



## KEY CONCEPTS

**Frostbite**

- Premature termination of thawing in 37°C to 39°C (98.6°F–102.2°F) water is a common error. Reperfusion of completely frozen tissue may be painful and may require parenteral analgesia.
- The early formation of clear blebs is more favorable than delayed formation of hemorrhagic blebs, which reflect damage to the subdermal vascular plexi.
- The patient should be advised that accurate prediction of eventual tissue loss is not always possible at presentation, despite imaging.

- Thrombolytic agents may restore some flow to severely frostbitten limbs if administered within 24 hours of thawing.

**Nonfreezing Cold Injuries**

- Immersion injuries should be rewarmed slowly and not above 30°C (86°F).
- Cooling of nonfreezing cold injuries may be helpful to relieve pain and edema.
- Pernio can be treated by drying and gentle massage. The skin should not be warmed above 30°C (86°F).

## CHAPTER 131: QUESTIONS &amp; ANSWERS

**131.1.** What is the most common presenting symptom of frostbite?

- A. Blisters
- B. Discoloration
- C. Numbness
- D. Pain
- E. Skin sloughing

**Answer:** C. Numbness is the presenting symptom in more than 75% of cases. Even when numbness is not the presenting symptom, it is still present in all cases of frostbite. Pain often does not develop until rewarming and the reestablishment of perfusion. Discoloration, blister formation, and skin sloughing can all occur but are often delayed by hours to days or weeks.

**131.2.** A 27-year-old man presents complaining of numb feet and hands. Several hours ago, he returned from an overnight hike in some nearby mountains. He reports that the temperature was consistently below  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ ). After immediate rewarming, you reexamine his hands and feet. Which of the following, if present, would portend the worst prognosis?

- A. Bounding pulses
- B. Edema
- C. Large clear vesicles
- D. Pale color
- E. Violaceous hue

**Answer:** E. After rewarming, extremities may still remain slightly pale or become slightly erythematous, both of which are normal. A violaceous hue indicates more severe damage. Edema is actually an expected and favorable finding. Lack of edema again indicates severe damage and lack of circulation. Large clear vesicles are also expected and are not poor prognostic indicators. However, the formation of small hemorrhagic vesicles is a poor prognostic sign. These vesicles usually form somewhat later in the course. Pulslessness would be a poor sign, but return of pulses or even bounding pulses should be expected.

**131.3.** At initial presentation of a frostbite injury, which imaging modality is indicated?

- A. Computed tomographic angiography
- B. Doppler ultrasonography
- C. Magnetic resonance angiography (MRA)
- D. Plain film radiography
- E. Scintigraphy

**Answer:** D. Multiple studies, including the other four listed, have been tested to predict the extent of tissue loss accurately, but none have been consistently successful. Plain film radiography is indicated to evaluate for other injury. Because frostbite results in near-total anesthesia of the extremity, accompanying skeletal

injury can go undiagnosed. Subsequently, MRA may help predict the line of demarcation for tissue loss. The patient should be advised that, in severe cases, accurate prediction of eventual tissue loss is not possible at presentation.

**131.4.** What is the best method to rewarm a frostbitten extremity?

- A. Manual friction
- B. Room temperature air convection
- C. Room temperature water immersion
- D. Warm air convection
- E. Warm water immersion

**Answer:** E. Ideally, water should be 37°C to 39°C (98.6°F–102.2°F). Additional damage can be caused when the water temperature exceeds 42°C (107.6°F). In general, water temperature of 35°C to 39°C (95°F–102.2°F) is rapidly effective, well tolerated, and will not cause additional injury. Typically, 10 to 30 minutes is required. Analgesia is necessary during rewarming because pain should be expected. Friction is contraindicated because this will almost always cause additional injury. Room temperature air, water, and warm air will all slowly thaw a frostbitten extremity, but the length of time frozen is directly related to the extent and degree of injury, so rewarming should be accomplished using the quickest measures.

**131.5.** What is the most common error made when treating frostbite injury?

- A. Débridement of broken blisters
- B. Inadvertently causing systemic hyperthermia during thawing
- C. Premature termination of thawing
- D. Use of nonsteroidal antiinflammatory drugs (NSAIDs) for analgesia
- E. Use of thrombolytic agents to restore blood flow

**Answer:** C. Often, a patient's extremities are initially thawed appropriately with circulating warm water, but the thawing is terminated because of severe pain. Pain during thawing is typical and should be expected. Parenteral analgesics are necessary. Broken blisters should be debrided, clear blisters can be aspirated or debrided, and hemorrhagic blisters should be left intact. Inadvertently causing systemic hypotension can occur because many frostbite patients are already cold. Submerging an extremity in warm water will cause local vasodilation and may actually cause systemic hypothermia. An NSAID is the drug of choice for analgesia because the inhibition of thromboxane and arachidonic acid may improve long-term outcome (this is controversial, but NSAIDs are still effective). Thrombolytic agents, such as tissue plasminogen activator (tPA; in small studies), improve outcome and decrease digit amputations.

## KEY CONCEPTS

- Indications for active rather than passive rewarming include cardiovascular instability, temperature below 32°C (89.6°F), poor rate of rewarming, and endocrinologic insufficiency.
- Consider hypoglycemia, hypovolemia, or an overdose if there is a tachycardia disproportionate to the temperature.
- The efficacy of most medications is temperature-dependent. Overmedication to achieve an effect when the patient is cold could cause toxicity during rewarming.
- Laboratory coagulation tests are performed at 37°C (98.6°F). Despite a clinically obvious coagulopathy, the values will be deceptively normal.
- There are no safe predictors of serum electrolyte levels. Hypothermia enhances the cardiac toxicity of hyperkalemia and obscures premonitory electrocardiographic changes.
- Failure to rewarm despite good technique should suggest infection, endocrine insufficiency, or a futile resuscitation.

## CHAPTER 132: QUESTIONS &amp; ANSWERS

**132.1.** What type of energy transfer results in the greatest amount of heat loss in a cold environment?

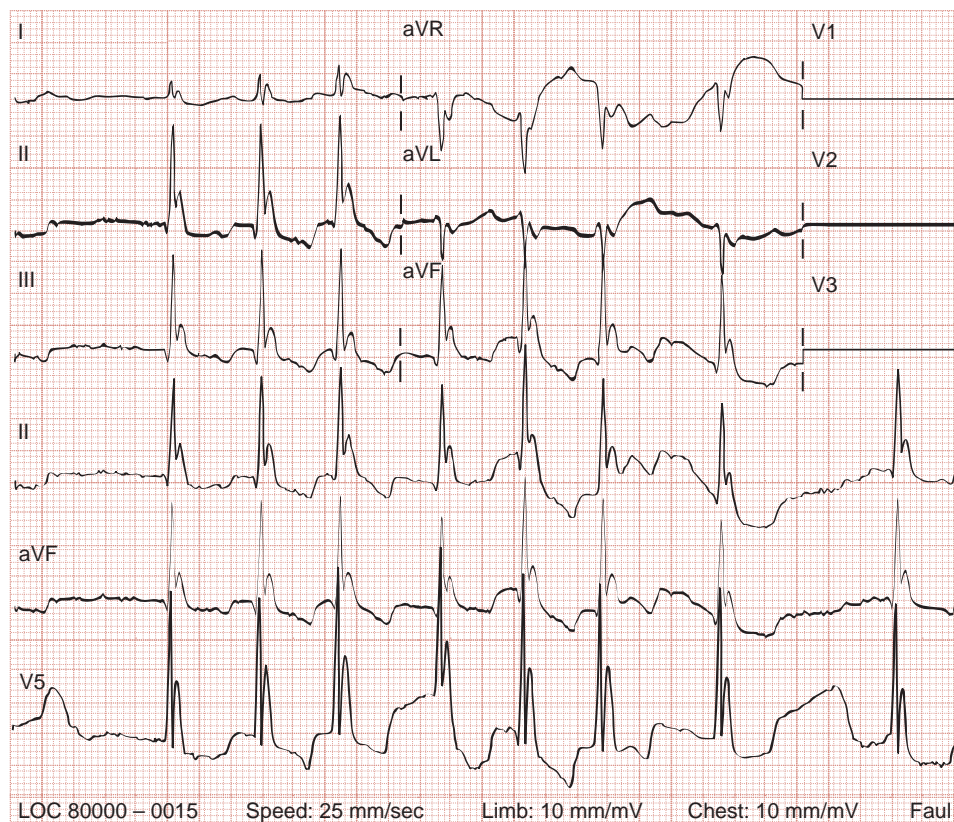
- A. Conduction
- B. Convection
- C. Evaporation
- D. Radiation
- E. Respiration

**Answer: D.** At an average metabolic rate, radiation accounts for 55% to 65% of heat loss. Heat loss through radiation depends on the temperature gradient of the person and environment. A greater differential results in greater heat loss. Heat loss through radiation can be minimized by reducing the body surface area (curling up), warming the room or, most effectively, insulation. Conduction is the transfer of heat between two objects in direct contact (eg, bare feet on a tile floor) and only accounts for 2% or 3% of heat loss, but can increase up to 25 times in cases involving submersion. Convection is the transfer of heat to a fluid medium (air or liquid) as it moves across the body. This usually accounts for approximately 10% of heat loss but is increased when shivering or in windy conditions. Respiration accounts for approximately 30% of heat loss and is relatively constant. Evaporation (sweating) is the dominant mode of heat loss in hot environments but is negligible in cold environments.

**132.2.** Emergency medical services (EMS) notifies your emergency department (ED) that an unknown male who was “found down” is being transported. No history is available. Paramedics report that the patient’s pulse is 42 beats/min and blood pressure is difficult to obtain. Spontaneous respirations are present at a rate of 10 breaths/min. The electrocardiogram (ECG) shown here is faxed before the patient’s arrival. What treatment should you administer upon the patient’s arrival?

- A. Epinephrine intravenous (IV)
- B. Normal saline bolus
- C. Pericardiocentesis
- D. Synchronized cardioversion
- E. Warming the patient

**Answer: E.** The patient has the classic electrocardiographic finding of hypothermia, the Osborn or J wave. The wave is seen at the junction of the QRS complex and ST segment. Depending on the lead, the wave can be mistaken for ST segment elevation myocardial infarction (STEMI), early repolarization, or simply a widened QRS of unknown cause. The Osborn wave is potentially diagnostic of hypothermia and may be seen at any temperature below 32°C (89.6°F). Epinephrine is potentially indicated in cardiac arrest. Crystalline fluid boluses are generally indicated for any hypotensive patient, especially when hypovolemia is suspected. Pericardiocentesis is only indicated for cardiac tamponade. Synchronized cardioversion is indicated for a variety of tachyarrhythmias.



- 132.3.** Rapid rewarming is the mainstay of treatment for hypothermia. However, rewarming can cause complications. Which of the following complications should be anticipated and prevented when rewarming a hypothermic patient?
- A. Cerebral edema
  - B. Hypokalemia
  - C. Hyponatremia
  - D. Hypotension
  - E. Rhabdomyolysis

**Answer: D.** When the surface or extremities of a patient are initially warmed, the cold-induced peripheral vasoconstriction is reversed. Rapid peripheral vasodilation can result in up to a 50% decline in peripheral vascular resistance and a 30% decline in mean arterial pressure. The effects are particularly prominent in patients who are also dehydrated—and exposure to cold induces a diuresis—or have frostbitten extremities. The same vasodilation is responsible for core temperature afterdrop, which refers to a further decline in core temperature, partially resulting from the fact that blood is now perfusing cold tissue, and the cold blood is returned to the core. This core afterdrop can also increase the incidence of dysrhythmias. Rhabdomyolysis is commonly seen in hypothermic patients but not specifically when rewarming. None of the other answer choices are commonly seen on rewarming a hypothermic patient.

- 132.4.** A 4-day-old male patient is brought in by parents for poor feeding. His birth history is uneventful; he was full term. He was discharged from the hospital with his mother 2 days ago. Vital signs are within normal limits for his age, with the exception of a temperature of 33.5°C (92.3°F). Physical examination reveals a drowsy but arousable boy. Otherwise, the physical examination is unremarkable. What is the most likely diagnosis?
- A. Congenital heart disease
  - B. Hypernatremia
  - C. Hyponatremia
  - D. Sepsis
  - E. Still's disease

**Answer: D.** Neonates have poor thermoregulatory mechanisms, and neonatal hypothermia is relatively common after precipitous delivery. However, with proper care, the hypothermia resolves and does not cause long-term problems. Hypothermia 72 hours after birth is frequently caused by sepsis. A full septic evaluation is indicated in this case. Neonatal hypothermia is also associated with hypoglycemia and child neglect or abuse. Poor feeding and dehydration can result in hyperthermia, whereas dilution of infant formula can result in hyponatremia. Neither should result in hypothermia. Congenital heart disease frequently presents with distress during feedings but, similarly, should not result in hypothermia. Still's disease is a rare rheumatologic disease associated with fever, arthralgia, and rash.

- 132.5.** Which substance directly interferes with thermoregulatory neurotransmitters, may directly damage the thermoregulatory centers of the brain, and therefore predisposes to hypothermia?
- A. Cocaine
  - B. Ethanol
  - C. Nicotine
  - D. Phencyclidine
  - E. Tetrahydrocannabinol (THC)

**Answer: B.** Ethanol interacts with all thermoregulatory neurotransmitters and may damage the posterior hypothalamus and mammillary bodies. It also causes vasodilation and decreased shivering, as well as inhibiting normal adaptive behavior to cold. In urban settings, most cases of hypothermia are associated with ethanol. Cocaine and phencyclidine are stimulants and may cause hyperthermia. Nicotine and THC do not directly interact with the thermoregulatory centers.

- 132.6.** A 47-year-old man is brought to the ED after being “found down.” No further history is available. His vital signs are normal with the exception of temperature, which is 31°C (87.8°F). He is lethargic and only responds to painful stimuli by withdrawing. He has several scalp lacerations that are bleeding profusely. You appropriately intubate this patient to secure his airway. Despite direct pressure, injection of epinephrine, and all other techniques at your disposal, the patient continues to bleed from his scalp lacerations. You also notice multiple new areas of bruising and bleeding on various parts of the patient. What should be done to reverse the coagulopathy most rapidly?
- A. Intranasal desmopressin
  - B. IV vitamin K
  - C. Transfusion of fresh-frozen plasma (FFP)
  - D. Transfusion of platelets
  - E. Warming the patient

**Answer: E.** Hypothermia decreases the activity of all clotting factors, which can result in disseminated intravascular coagulation. The only effective treatment is to warm the patient. There is nothing inherently wrong with the patient's clotting factors; they are merely inactivated by the cold. Any additional clotting factors transfused will also be inactivated by the cold. Hypothermic patients are not thrombocytopenic. Desmopressin enhances the release of von Willebrand factor and factor VIII. Vitamin K is needed for the synthesis of factors II, VII, IX, and X. FFP provides all clotting factors.

- 132.7.** A 30-year-old woman in cardiac arrest is brought to the ED by emergency medical services. She was intubated in the field, and chest compressions have been continuously performed. Her temperature is 25°C (77°F). When placed on the cardiac monitor, she is noted to be in ventricular fibrillation. A defibrillation attempt is made at the appropriate setting, but she remains in ventricular fibrillation. A nurse resumes providing chest compressions and asks for further instructions. What should be done next?
- A. IV amiodarone
  - B. IV lidocaine
  - C. IV procainamide
  - D. Repeating defibrillation
  - E. Warming the patient

**Answer: E.** Defibrillation attempts are usually unsuccessful at core temperatures less than 32°C (89.6°F). Chest compressions should continue while the patient is aggressively warmed. Many dysrhythmias spontaneously convert once hypothermia is resolved. If ventricular fibrillation persists at temperatures above 30°C (86°F), another defibrillation attempt should be made. Amiodarone, lidocaine, and procainamide are all antidysrhythmics that could potentially be used in normothermic patients.

- 132.8.** Which of the following is an indication for active rather than passive rewarming in a hypothermic patient?
- A.** Altered mental status
  - B.** Associated burns
  - C.** Associated trauma
  - D.** Hypoglycemia
  - E.** Temperature below 32°C (89.6°F)

**Answer: E.** Other indications for active rewarming include cardiovascular instability, poor rate of rewarming, endocrinologic insufficiency, and vasodilation.

- 132.9.** Which of the following patients meets the definition of hypothermia?
- A.** A patient with a core temperature of less than 35°C (95°F) but with no symptoms
  - B.** A patient with a core temperature of less than 36°C (96.8°F) with symptoms of hypothermia
  - C.** A patient with an oral temperature of less than 34°C (93.2°F) but with no symptoms
  - D.** A patient with an oral temperature of less than 35°C (95°F) with symptoms of hypothermia
  - E.** A patient with frostbite, regardless of temperature

**Answer: A.** Hypothermia is defined as a core temperature less than 35°C (95°F). Oral temperatures are not reliable. The presence or absence of symptoms can guide management but does not change the definition of hypothermia.

- 132.10.** The search for a valid triage marker of death in the setting of severe hypothermia continues. Which of the following is most suggestive?

- A.** Ammonia level, 100 mmol
- B.** Fibrinogen, >50 mg/dL
- C.** Hyperkalemia, 9 mEq/L
- D.** International normalized ratio (INR) of 3.2
- E.** Low blood urea nitrogen (BUN) level

**Answer: B.** Ominous markers include an ammonia level > 250 mmol/L, hyperkalemia (cell lysis) > 10 to 12 mEq/L, fibrinogen < 50 mg/dL (intravascular thrombosis). The INR is not prognostic because kinetic tests of coagulation are performed in the laboratory at 37°C (98.6°F).



**Resuscitation.** Mortality correlates with the temperature and number of dysfunctional organ systems, with an increased risk of death if patients present with anuria, coma, or cardiovascular failure. Aspiration and seizures are common in patients with heatstroke, and airway control is indicated. Hypoxemia may occur because of aspiration, pneumonitis and pulmonary infarction, hemorrhage, or edema. Metabolic demands are high, and normal pulmonary ventilation may be inadequate in this setting.

Crystalloid fluid resuscitation is essential. Circulatory fluid requirements are modest in some cases, averaging 1200 mL of isotonic crystalloid solution in the first 4 hours. Pulmonary edema occurs in patients with heatstroke and can be exacerbated by overzealous fluid administration. The use of a CVP catheter to monitor fluid resuscitation may be deceptive. Most patients have a hyperdynamic circulation with a high cardiac index, low peripheral vascular resistance, and elevated CVP as a result of right-sided heart failure. These patients may require only modest IV fluids because cooling produces vasoconstriction and increases blood pressure. Hypotension is common in patients with heatstroke and is usually caused by peripheral vasodilation resulting in high-output cardiac failure in addition to dehydration. Blood pressure usually rises with cooling. If this does not occur, or if the patient being monitored invasively has a low CVP, a fluid challenge of 250 to 500 mL of 0.9% saline should be given rapidly while blood pressure, pulse, and urine output are monitored. Fluid replacement is continued until the blood pressure reaches 90/60 mm Hg or the CVP exceeds 12 mL H<sub>2</sub>O. On occasion, patients exhibit hypodynamic responses with a low cardiac index, elevated CVP, and hypotension. These patients may be cyanotic, whereas patients with hyperdynamic circulation are initially pink. This clinical observation can be helpful in identifying patients who may respond to catecholamines.

A variety of tachyarrhythmias commonly occur during heatstroke. These usually resolve with cooling, and electrical cardioversion should be avoided until the myocardium is adequately cooled. The use of  $\alpha$ -adrenergic agents such as norepinephrine is not recommended because they promote vasoconstriction without improving cardiac output or perfusion, decrease cutaneous heat exchange, and may exacerbate ischemic renal and hepatic damage. Atropine and other anticholinergic drugs that inhibit sweating should be avoided.

The pathophysiologic processes of heatstroke and fever differ, so antipyretics are not indicated and may be harmful. Salicylates,

particularly in large doses, may worsen hyperthermia by uncoupling oxidative phosphorylation and aggravating coagulopathies. Large doses of acetaminophen can result in further hepatic damage. The efficacy of dantrolene has not been established.

If rhabdomyolysis is present, maintenance of urinary output of at least 2 mL/kg/hr is recommended. Urinary alkalization higher than a pH of 6.5 should be considered early in these patients with acidemia, dehydration, or underlying renal disease. After volume repletion, administration of mannitol may be considered to increase intravascular volume and increase the glomerular filtration rate. Mannitol should not be used in an oliguric patient. Persistent anuria, uremia, or hyperkalemia is an indication for consideration of hemodialysis.

Cooling modalities that drastically lower skin temperature may induce violent shivering; this increases metabolic heat production and may impede cooling. IV benzodiazepines are the treatment of choice for shivering. The administration of neuroleptics, like chlorpromazine, should be avoided. These agents have anticholinergic properties that can interfere with sweating and cause hypotension or precipitate seizures. Many patients are extremely agitated during the initial cooling period. Short-acting benzodiazepines can be used for sedation and to control seizures. Barbiturates are less desirable because the metabolism is altered by hepatic dysfunction.

Coagulopathies can occur during the first day of illness but are more common on the second and third days. Initial treatment after cooling should include replacement therapy with fresh-frozen plasma and platelets. The emergency clinician should monitor the laboratory signs of DIC—(hypofibrinogenemia, elevated fibrin split products, prolonged prothrombin time, and thrombocytopenia). The bleeding diathesis seen in patients with heatstroke may be the result of fibrinolysis. Although  $\alpha$ -aminocaproic acid can impede fibrinolysis, administration of this compound is associated with rhabdomyolysis, and its use is not recommended in patients with heatstroke.

## Disposition

Patients presenting with classic or exertional heat stroke should be stabilized in the ED, with admission to an intensive care setting. Patients with more complex end-organ damage (eg, renal failure requiring dialysis) may require transfer to a center with more comprehensive tertiary care capabilities.



## KEY CONCEPTS

- Classic heatstroke is generally diagnosed in older patients with comorbidities during heat waves, whereas exertional heatstroke is more common in young athletic patients or military personnel.
- Patients with exertional heatstroke are commonly diaphoretic.
- Rapid cooling of the potential heatstroke patient should be initiated before the diagnosis is firmly established. The most effective minimally invasive cooling measure is with evaporative techniques using cool mist sprays and standing fans.
- Antipyretics are ineffective and should not be used to control environmental hyperthermia.
- Heatstroke can cause right-sided cardiac dilation and elevated CVP and clinically resemble pulmonary edema, but still requires vigorous crystalloid resuscitation.

## CHAPTER 133: QUESTIONS &amp; ANSWERS

- 133.1.** An 18-year-old female marathon runner presents to the ED during a hot summer race. She is extremely irritable and diaphoretic. She is complaining of generalized weakness, dizziness, nausea, and headache. The physical examination reveals an oral temperature of 40.5°C (105°F), heart rate of 120 beats/min, muscle twitching, and ataxia. What is the most appropriate management?
- Assess her volume status and immediately start normal saline to replete volume loss before transfer to a hospital.
  - Encourage her to drink cold water to replace her free water deficit rapidly.
  - Immediately remove her from the hot environment and begin cooling before transfer to a hospital.
  - Prescribe immediate rest, after which she may be allowed to finish the race.

**Answer: C.** The onset of heatstroke is sudden. Prodromal symptoms lasting minutes to hours can occur that are nonspecific and similar to those of heat exhaustion. Signs and symptoms may include weakness, dizziness, nausea, frontal headaches, confusion, muscle twitching, ataxia and signs of cerebellar dysfunction, and psychiatric symptoms, ranging from anxiety and irritability to psychosis. Heat exhaustion can progress to heatstroke if it is untreated. If the patient is evaluated as this is occurring, differentiation between heat exhaustion and heatstroke is difficult. If heatstroke cannot be excluded, efforts to cool the patient should begin immediately.

Whereas rest is part of the treatment for heat exhaustion, it is not the only treatment. She must be removed from the hot environment, not be allowed to finish the race, and assessed for her volume status. Normal saline is used to replete volume if the patient is orthostatic; free water deficits are replaced slowly to avoid cerebral edema.

- 133.2.** Which of the following statements regarding heat exhaustion is true?
- It causes body temperatures that often exceed 40.5°C (105°F).
  - It exists in two discrete forms, salt depletion and water depletion.
  - It is associated with systemic symptoms.

- It is characterized by hyponatremia and hyperchloremia.
- It occurs when muscles are fatigued by heavy work.

**Answer: C.** Heat exhaustion is a clinical syndrome. Whereas there are typically two types of heat exhaustion, water depletion and salt depletion, pure forms of either type are rare. Most cases of heat exhaustion involve mixed salt and water depletion. In salt depletion heat exhaustion, the syndrome is characterized by hyponatremia, hypochloremia, and low urinary sodium and chloride concentrations. The symptoms and signs associated are variable and nonspecific but usually systemic, such as weakness, fatigue, frontal headache, vertigo, nausea, and vomiting. The body temperature usually remains nearly normal.

- 133.3.** Despite cooling measures, poor outcomes are seen in heatstroke patients with which of the following?
- Altered coagulation status
  - History of schizophrenia
  - Need for 100% oxygen
  - Presentation with acute renal failure
  - Presentation with acute rhabdomyolysis

**Answer: A.** Factors such as advanced age, hypotension, altered coagulation status, and the necessity for endotracheal intubation on arrival at the ED predict a poor outcome, despite successful cooling measures.

- 133.4.** The usual characteristics of classic heatstroke include which of the following?
- Diaphoresis
  - Disseminated intravascular coagulation
  - Hypoglycemia
  - Marked lactic acidosis
  - Usual occurrence during heat waves

**Answer: E.** Usual characteristics of classic heatstroke include predisposing factors or medication, older population, sedentary lifestyle, anhidrosis, normoglycemia, mild coagulopathy, mild elevation in creatine kinase level, oliguria, mild acidosis, and occurrence during heat waves. Diaphoresis, hypoglycemia, disseminated intravascular coagulation, and marked lactic acidosis are characteristics of exertional heatstroke.

## KEY CONCEPTS

- Electrical current follows the path of least resistance, often neurovascular bundles. Deep tissue and organ damage is often much more extensive than would be indicated by examination of the overlying skin.
- Testing is not indicated for victims of low-voltage electrical injuries who are asymptomatic or have minimal local symptoms and physical evidence of burn injury. These patients may be discharged home after evaluation.
- Testing is indicated for patients exposed to high-voltage sources and those with syncope, altered mentation, or any other neurologic abnormality, significant burns, entry and exit wounds, or significant ongoing symptoms. Testing should include electrocardiography, complete blood count, basic chemistry panel, myoglobin and troponin level determination, and urinalysis. Additional testing is directed at suspected areas or injuries.
- Patients with electrocardiographic signs of cardiac injury or dysrhythmias, or with evidence of significant local injury, should be monitored for at least 6 hours in the ED, observation unit, or inpatient setting.
- The enormous current of a lightning strike may cause critical injury or death, or the current may be directed superficially over the patient to the ground, resulting in no injury or only superficial burns.
- Electrocardiography is indicated for all patients evaluated for lightning strike. Additional testing should be based on specific signs and symptoms.
- Lightning strike patients who present without symptoms or signs of injury, or with only minor first-degree burns, and with a normal ECG can be discharged home after evaluation. Patients who present with altered mentation or significant symptoms are evaluated in a manner similar to that used for victims of high-voltage electrical injury.
- Lightning strike can cause fixed, dilated pupils in the absence of irreversible brain injury.

## CHAPTER 134: QUESTIONS &amp; ANSWERS

- 134.1.** A man walking through a park after a storm accidentally steps on a downed electrical wire and is rendered unconscious. Before rescuing him, how can prehospital providers ensure their own safety and that of bystanders?
- Call the power company to disconnect the power.
  - Loop a leather belt around the wire to move it.
  - Use a dry rope to loop around the wire and pull it away from the victim.
  - Use a tree branch or piece of wood, such as a 2 by 4, to move the wire.
  - Use electrical gloves to move the wire manually.

**Answer: A.** The prime tenet of rescue work is create no further victims. The only safe and reliable way to ensure that the power is off is to notify the power company to have the power turned off. None of the other choices is safe, and they could result in severe injury to the rescuer using them.

- 134.2.** A 37-year-old woman presents with blurred vision. Her vision has been progressively worsening for approximately 2 months. She denies eye pain or direct eye trauma. She reports that approximately 2 months ago, just before the beginning of her vision problems, she was struck by lightning while playing golf. She states that she went to an emergency department (ED) at that time, had no major injuries, and seems to have recovered well. What is the most likely cause of her decreased vision?
- Cataracts
  - Glaucoma
  - Iritis
  - Macular degeneration
  - Retinal detachment

**Answer: A.** Cataracts are a well-known complication of electrical injury, either from artificial electrical sources or from lightning. They may occur immediately or have a delayed presentation. Approximately 6% of victims of electrical injury develop cataracts. Glaucoma is due to elevated intraocular pressure and is often painful. Iritis and retinal detachment can be caused by electrical injury but are manifested acutely. Macular degeneration is a chronic condition of older adults with central vision loss and is not associated with electrical injury. Macular holes may occur acutely with lightning injury.

- 134.3.** A 42-year-old man suffers an electrical injury while working on power transmission lines near your hospital. Paramedics report that he is unresponsive and that he was initially in ventricular fibrillation but spontaneously converted to sinus tachycardia before treatment. His initial electrocardiogram (ECG) from the field shows ST

segment elevation in the inferior leads. An ECG repeated in the ED shows continued inferior ST segment elevation but with decreased magnitude. Creatine kinase (CK) and CK-MB levels are markedly elevated. He continues to be unresponsive, has no spontaneous respirations, and has bilateral fixed and dilated pupils. What is the appropriate next action?

- Brain death testing
- Cardiac catheterization
- Mannitol infusion
- Observation and supportive care
- Thrombolytic administration

**Answer: D.** Electrical injury can cause a variety of cardiac manifestations, including multiple dysrhythmias, transient ST elevation, and conduction blocks. Myocardial infarction, although reported, is rare. Extensive skeletal muscle damage can be seen in electrical injuries and results in marked elevations of CK and CK-MB levels. Respiratory muscle paralysis and ocular injuries often occur. This patient is probably not brain-dead, nor has he suffered a myocardial infarction. Mannitol is used in cases of impending cerebral herniation, which is not expected in this patient.

- 134.4.** A 3-year-old boy is brought to the ED by his parents after burning his mouth while chewing on an electrical cord. He has partial-thickness burns to the left side of his upper and lower lips and an oral commissure. What complication of this injury needs to be considered in planning patient treatment and disposition?
- Cardiac dysrhythmias
  - Cataracts
  - Contractures involving the orbicularis oris muscle
  - Delayed labial artery bleeding
  - Rhabdomyolysis

**Answer: D.** When the initial eschar separates, there is risk of exposure of the labial artery, with resultant significant arterial bleeding. Traditionally, admission for observation has been advocated for these patients but, if there is good social support, discharge with specific instructions and close follow-up are appropriate. These types of electrical injury have only local effects, so dysrhythmias, cataracts, and rhabdomyolysis are not complications. Contractures are common and may require reconstructive surgery, but this complication is not life-threatening.

- 134.5.** You are camping with a group of five students. A sudden thunderstorm arises and lightning strikes your camp. You are uninjured, but all five students are injured and are lying on the ground. Their conditions are described here.

You are the only person available to provide medical support. After quickly calling 911, which student should receive your primary attention?

- A. Student A is unconscious and has no spontaneous respirations, an irregular pulse, and no obvious injuries.
- B. Student B is unconscious and has spontaneous respirations, a rapid and faint pulse, and no obvious injuries.
- C. Student C is conscious, is screaming in pain, and has an easily palpable pulse and obvious open femur fracture after being thrown against a tree.
- D. Student D is conscious, is screaming in pain and has an easily palpable pulse and obvious second- to third-degree burns involving his face, left arm, and left leg.
- E. Student E is conscious, is talking rapidly, has an easily palpable pulse, and complains of complete blindness.

**Answer: A.** This student has suffered respiratory arrest. Unlike in traditional mass casualty triage guidelines, patients without spontaneous respirations take first priority. Lightning frequently causes complete cardiopulmonary arrest, but cardiac automaticity often returns spontaneously. However, respiratory muscle paralysis can persist for several minutes. If patients are adequately ventilated during this time, prognosis for recovery is excellent. Student B may have a dysrhythmia or internal injuries causing shock. Although both conditions are potentially serious, there is

little that a single rescuer in the field can do. Patients without cardiopulmonary arrest rarely die in the field.

- 134.6.** A 29-year-old man is brought to the ED after a reported lightning strike. He is unresponsive and has been intubated before arrival by emergency medical services. The monitor reveals a sinus tachycardia at a rate of 125 beats/min, and his blood pressure is 196/118 mm Hg. Pupils are fixed and dilated. The lower extremities are cool and mottled, with absent pulses in the feet. Which of the following is the most appropriate for managing the patient?
- A. Begin heparin, order lower extremity angiography, and consult vascular surgery.
  - B. Consult neurosurgery for determination of brain death.
  - C. Initiate treatment for hypertension with a titratable intravenously infused beta blocker.
  - D. Obtain a computed tomography (CT) scan of the head.

**Answer: D.** Nonreactive pupils are not a reliable method of determining neurologic status immediately after lightning injury. Vasospasm may result in pulseless mottled extremities but usually resolves spontaneously within a few hours. Similarly, hypertension is common and should not be treated initially. Any patient with loss of consciousness or persistent neurologic impairment should have CT scanning of the head to rule out an intracranial anatomic cause.



## KEY CONCEPTS

- The majority of dive injuries are diagnosed on the basis of the focused dive history and physical examination alone and are best differentiated into disorders of descent, disorders of depth, and disorders of ascent.
- The *U.S. Navy Diving Manual* and the Divers Alert Network (DAN) are valuable resources for the clinician presented with a diving emergency. DAN provides a 24-hour medical emergency hotline at 1-919-684-9111 (collect calls are accepted) and a nonemergency advisory line Monday through Friday, 8:30 AM to 5 PM Eastern time, at 1-919-684-2948 or 1-800-446-2671 (see [Box 135.3](#)).
- Treatment with 100% oxygen is the initial therapy for all diving emergencies until the diagnoses can be determined. It has been demonstrated to reduce the morbidity and mortality related to decompression illness and can be helpful in patients with pneumothorax.
- Imaging and laboratory studies are not useful for ruling in decompression and should not delay definitive recompression therapy.
- With the exception of DCS, AGE, and possibly carbon monoxide poisoning from contaminated air, most dive-related disorders can be treated without recompression therapy. Recompression treatment is recommended for patients with DCS and AGE.

## CHAPTER 135: QUESTIONS &amp; ANSWERS

135.1. When is a diver most likely to suffer barotrauma?

- A. When the diver also suffers from decompression sickness (DCS)
- B. When the diver is at extreme depth
- C. When the diver is near the surface
- D. When the diver stays at depth for an extended period of time
- E. When the diver uses specialized gas mixtures with decreased partial pressure of nitrogen

**Answer: C.** Barotrauma refers to injuries due to pressure changes. Boyle's law states that pressure and volume are inversely proportional ( $P \times V = k$  or  $P_1 V_1 = P_2 V_2$ ). As the pressure decreases, the volume of gas increases and can damage gas-filled structures (sinuses, inner/middle ears, lungs, and intestines). The incremental changes in pressure (and therefore volume) are greatest at the surface, so barotrauma most commonly occurs near the surface (either at the beginning or at the end of a dive). Long or deep dives are not required for barotrauma.

135.2. A 55-year-old man presents with the acute onset of left-sided weakness and confusion. Family members report that they are on vacation and had just finished scuba diving when the patient complained of chest pain, became confused, and stopped moving his left arm and leg. This happened 30 minutes ago. The patient has no known medical history and takes no medications. Physical examination reveals a drowsy and confused male who follows commands but does not move his left arm or leg. His blood pressure is 162/98 mm Hg, and his other vital signs are within normal limits. What is the appropriate treatment?

- A. Computed tomography (CT) of the brain
- B. Endotracheal intubation
- C. Intravenous labetalol
- D. Intravenous tissue plasminogen activator
- E. Recompression in a dive chamber

**Answer: E.** This patient has suffered an arterial gas embolism (AGE). In AGE, air bubbles gain access to the arterial circulation and can cause mechanical obstruction of the artery. Symptoms can mirror an acute thrombotic or embolic event including myocardial infarction or stroke. Treatment with 100% oxygen should be instituted immediately, but the only definitive treatment is emergent recompression.

135.3. Which of the following individuals should be advised not to dive?

- A. A 10-year-old boy with no known medical problems
- B. A 19-year-old woman with no medical problems but who just landed from an intercontinental commercial flight

- C. A 20-year-old man with well-controlled asthma
- D. A 27-year-old woman who is 20 weeks' pregnant
- E. A 70-year-old man with asymptomatic coronary artery disease

**Answer: D.** Upon surfacing, small nitrogen bubbles form in the circulation of all divers. If proper technique is followed, these bubbles are small and asymptomatic. They form in the venous circulation and are eliminated in the lungs. However, if these bubbles are transmitted into the arterial system, embolization with serious consequences can occur. The fetus has a patent foramen ovale (PFO) and ductus arteriosus, both of which would allow air to bypass this filtering effect of the lungs and proceed into the systemic circulation. Therefore adults with a known PFO should not dive. Asthmatics can dive as long as symptoms are well controlled. There are no definite age recommendations for diving. Flying immediately after diving should be avoided; flying prior to diving is of less concern.

135.4. A 24-year-old woman presents with complaints of severe chest pain and shortness of breath. The symptoms started approximately 1 hour ago while surfacing from a dive. She denies loss of consciousness or other symptoms. Physical examination reveals decreased breath sounds in the right chest and crepitus in her neck; otherwise, it is normal. Vital signs are normal except for a slight tachypnea. A chest radiograph shows a moderate right-sided pneumothorax and a pneumomediastinum. You place a chest tube on her right side. What is the next course of action?

- A. Computed tomography (CT) of the brain
- B. CT of the chest
- C. Observation and supportive care
- D. Pericardiocentesis
- E. Recompression in a dive chamber

**Answer: C.** This patient has suffered from pulmonary barotrauma. Although this injury does predispose one to arterial gas embolism (AGE), the diagnosis of AGE is clinical. The treatment for a pneumothorax from pulmonary barotrauma is the same as for a pneumothorax from another cause—that is, aspiration, catheter insertion, or chest tube placement. Management of pneumomediastinum is supportive. Recompression is only necessary for decompression sickness (DCS) or AGE, not for barotrauma.

135.5. A 32-year-old man presents with bilateral lower extremity numbness and weakness. The patient reports several days of scuba diving without incident until his most recent dive, when the symptoms started. Physical examination reveals bilateral lower extremity weakness and decreased sensation to pinprick and light touch. Priapism is also noted. The remainder of the physical



examination and all vital signs are within normal limits. You decide that recompression therapy is indicated, but your emergency department does not have a dive chamber and the nearest chamber is 50 miles away. The patient has been accepted in transfer. What is the most appropriate way to transfer this patient?

- A. Air ambulance, lying flat
- B. Air ambulance, Trendelenburg position
- C. Ground ambulance, lying flat
- D. Ground ambulance, Trendelenburg position
- E. This patient has not yet been stabilized for transport; he should remain at the current hospital.

**Answer: C.** This patient is suffering from spinal decompression sickness (DCS II). Recompression therapy is the treatment of choice. Unless an inordinate delay to the recompression chamber would result, anything that further decreases ambient pressure should be avoided (eg, flying). If a patient must be flown, the aircraft should fly at the lowest possible altitude or pressurize the cabin at the highest possible pressure. Traditionally, the Trendelenburg position was advocated because it was believed that it would decrease the incidence of AGE to the brain. This is not the case. In addition, the Trendelenburg position increases cerebral edema and the incidence of coronary artery air embolism. Therefore, the Trendelenburg position should never be used for patients with diving injuries.

**135.6.** A scuba tank is inadvertently filled with air that contains 100 ppm CO. The diver breathes the compressed air at the surface and has no symptoms. Twenty minutes later at a depth of 100 feet, the diver becomes symptomatic of carbon monoxide poisoning. Why?

- A. At depth, blood is preferentially shunted to the brain, so although the concentration of CO does not change, its effects become more prominent.
- B. At depth, the body becomes more sensitive to toxins of any sort.

- C. At depth, the partial pressure of CO increases and so the concentration in the blood also increases.
- D. At depth, the partial pressure of O<sub>2</sub> decreases and so the relative concentration of CO in the blood increases.
- E. The depth does not matter; the diver has now been breathing CO for 20 minutes and it has had time to dissolve in the blood.

**Answer: C.** The partial pressure of all gases increases with depth (pressure). This is Henry's law. At 100 feet, the total pressure on the body is approximately four times that on the surface. Likewise, the amount of gas dissolved in blood is approximately four times that on the surface. Thus at this depth, it is roughly equivalent to breathing air with a CO concentration of 400 ppm. The diver also has more O<sub>2</sub> dissolved in blood, but this cannot counter the effects of CO because it has a much higher affinity for hemoglobin. Blood flow is not changed at depth. In general, the body is not more susceptible to toxins at depth. Although the amount of time in contact with a poison (eg, CO) does correlate with effects, this is of negligible effect in this case.

**135.7.** You decide that a 27-year-old patient with an arterial gas embolism (AGE) following scuba diving requires recompression therapy. Which of the following treatments should be initiated before hyperbaric therapy?

- A. Administer 40% oxygen.
- B. Administer steroids.
- C. Ensure that the endotracheal tube and urinary catheter balloons are filled with water, rather than air.
- D. Place prophylactic thoracostomy tubes bilaterally.
- E. Place the patient in the Trendelenburg position.

**Answer: C.** Inflate endotracheal tube and urinary catheter balloons with sterile saline. There is no evidence that steroids are effective. The Trendelenburg position increases intracranial pressure and facilitates coronary gas embolization.

supportive care can be treated with benzodiazepines. Should an epileptic who is already taking seizure medicine experience a breakthrough seizure at altitude, standard seizure evaluation is warranted, and acetazolamide at 125–250 mg twice daily may be added. Acetazolamide itself has antiepileptic properties and may ameliorate the altitude-related metabolic derangements.

### Sickle Cell Disease

In patients with sickle cell disease, exposure to even low to moderate altitudes (4000 to 6500 feet) will provide additional hypoxia stress. Up to 20% of patients with hemoglobin sickle cell and sickle cell–thalassemia disease may experience a vaso-occlusive crisis, even under pressurized aircraft conditions. Oxygen is therefore advised for air travelers who have sickle cell disease.

Although most people with sickle cell trait remain asymptomatic, this subgroup can experience the development of left upper quadrant pain as a result of splenic ischemia or infarction. Non-blacks, usually of Mediterranean origin, who have sickle cell trait may be more prone to the development of splenic infarctions than are blacks.

### Pregnancy

Studies of permanent high-altitude residents in Colorado and Peru show an increased incidence of complications in maternal, fetal, and neonatal life. Infants born at high altitude have a lower birth weight compared with infants born at sea level because of a combination of factors, including altitude-related effects on fetal growth, changes in uterine blood flow, and increased premature births.

Pregnancy-induced hypertension, proteinuria, and peripheral edema (manifestations of toxemia and preeclampsia) are more common at high altitudes and may also be related to maternal and uterine hypoxemia.<sup>22</sup> Although hypertension in pregnancy is more common at high altitudes, no evidence exists for an increase in spontaneous abortions, abruptio placentae, or placenta previa.

Travel by pregnant women to moderate altitudes appears to be safe, but caution is advised for lowland women with normal pregnancies who wish to travel above 13,000 feet, for pregnant women who wish to remain at high altitude for a prolonged period, and for women with complicated pregnancies.

### Radial Keratotomy

Patient with a history of radial keratotomy may experience hyperopic (farsighted) visual changes with ascent above 9000 feet. This results from corneal swelling from ambient hypoxia because the cornea is markedly sensitive to both systemic and ambient oxygen tension.<sup>23</sup> In normal corneas, this swelling is uniform. After radial keratotomy, the swelling is exacerbated and inconsistent secondary to the pattern of the incisions. Photorefractive keratotomy and LASIK, which use laser techniques that do not produce incisions but instead shave the cornea and corneal stroma, respectively, do not result in similar problems.

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*The references for this chapter can be found online by accessing the accompanying Expert Consult website.*

## KEY CONCEPTS

- All forms of altitude illness can be treated with oxygen and rapid descent.
- The diagnosis of AMS requires the presence of headache in the setting of recent elevation change to greater than 8000 feet. Additional nonspecific symptoms may include nausea, anorexia, fatigue, and insomnia.
- Patients with AMS should not ascend further until symptoms improve. Patients with mild HAPE may be treated in place if experience providers and treatment options exist. Patients with moderate HAPE or HACE should descend immediately.
- Dyspnea at rest is an early symptom of HAPE. More advanced findings of HAPE include marked rest tachypnea, cough productive of frothy sputum, and altered mentation. Immediate treatment with oxygen and descent are recommended.
- Altered consciousness and cerebellar ataxia are early signs of HACE. Failure to initiate immediate treatment with oxygen, descent, and dexamethasone can result in permanent disability or death.
- AMS may be prevented by using acetazolamide or dexamethasone. Symptoms can be controlled with analgesia (ibuprofen and antiemetics). HAPE may be prevented using nifedipine, inhaled salmeterol, and phosphodiesterase type 5 inhibitors (sildenafil [40 mg every 8 hours] and tadalafil [10 mg every 12 hours]).<sup>50,132-134</sup> Temazepam (7.5 mg qhs) can safely improve sleep quality.

## CHAPTER 136: QUESTIONS &amp; ANSWERS

**136.1.** Which of the following individuals has the highest risk of developing high-altitude pulmonary edema (HAPE), assuming all are generally healthy, live at the same altitude, and travel to the same altitude?

- A. A 16-month-old boy
- B. A 19-year-old man
- C. A 19-year-old woman
- D. A 42-year-old man
- E. A 42-year-old woman

**Answer: B.** Many factors contribute to the development of HAPE including total altitude, sleeping altitude, time at altitude, previous acclimatization, and the presence of comorbidities. However, in general, both females and the elderly are less likely to develop HAPE. Also, whereas younger males are more at risk, HAPE is extremely rare in individuals younger than 2 years old regardless of gender.

**136.2.** Which of the following symptoms must be present to establish a diagnosis of acute mountain sickness (AMS)?

- A. Dizziness
- B. Fatigue
- C. Headache
- D. Insomnia
- E. Nausea

**Answer: C.** To diagnose AMS, a patient must have a recent gain in altitude, be at that altitude for several hours, and have a headache. In addition, at least one of the following must also be present: gastrointestinal upset, fatigue, dizziness or lightheadedness, or difficulty sleeping.

**136.3.** Which of the following medications used to treat acute mountain sickness (AMS) actually accelerates acclimatization?

- A. Acetazolamide
- B. Aspirin
- C. Dexamethasone
- D. Oxygen
- E. Prochlorperazine

**Answer: A.** Acetazolamide is a carbonic anhydrase inhibitor and induces a metabolic acidosis that results in increased ventilation. Aspirin is an appropriate treatment for the headache associated with AMS. Dexamethasone and oxygen both improve all symptoms of AMS but do not aid acclimatization. Prochlorperazine is appropriate treatment for the gastrointestinal upset caused by AMS and is preferred over promethazine because it does not depress the respiratory centers.

**136.4.** Which of the following conditions occurs more commonly at high altitude?

- A. Congestive heart failure (CHF)
- B. Myocardial infarction
- C. Pericarditis
- D. Pneumothorax
- E. Pulmonary embolism (PE)

**Answer: E.** Altitude causes hypercoagulability from hyperviscosity due to elevated hematocrit and dehydration. Venous stasis is also more common at altitude due to the relative immobility of sleeping in confined spaces (sleeping bags and small tents). Together, these facts lead to an increased risk of PE. Occasionally, PE may be misdiagnosed as high-altitude pulmonary edema (HAPE) and treated inappropriately.

**136.5.** High-altitude pulmonary edema (HAPE) can be difficult to distinguish from acute mountain sickness (AMS). Although the pathophysiology of each is similar, the treatment and prognosis are different. Which of the following features is indicative of HAPE as opposed to AMS?

- A. Diuresis
- B. Dyspnea at rest
- C. Headache
- D. Lower-extremity edema
- E. Symptom onset soon after arrival at altitude

**Answer: B.** Dyspnea on exertion is nearly universal at altitude and is not indicative of a pathologic process, but dyspnea at rest is not normal and is an early symptom of HAPE. Cough is common at altitude or any time when one breathes cold dry air. Fluid retention and peripheral edema are common manifestations of AMS, whereas a diuresis can be a sign of acclimatization. Neither AMS nor HAPE commonly occurs soon after arrival at altitude, with AMS usually occurring within 24 hours and HAPE usually occurring in 2 to 4 days.

**136.6.** The definitive treatment for high-altitude pulmonary edema (HAPE) is oxygen and descent to lower altitudes. Which of the following medications is also useful in the treatment of HAPE?

- A. Hydrochlorothiazide
- B. Metoprolol
- C. Nifedipine
- D. Nitroglycerin
- E. Verapamil

**Answer: C.** Nifedipine is a nonselective pulmonary vasodilator and is useful in the treatment and prevention of HAPE. Sildenafil and tadalafil may also be useful in the prevention of HAPE. These phosphodiesterase-5 inhibitors increase cyclic guanosine monophosphate availability and result in pulmonary vasodilation.

**136.7.** Which of the following signs or symptoms is specific for high-altitude cerebral edema (HACE) as opposed to acute mountain sickness (AMS) or high-altitude pulmonary edema (HAPE)?

- A. Ataxia
- B. Dizziness
- C. Dyspnea
- D. Headache
- E. Vomiting

**Answer: A.** Ataxia, seizures, slurred speech, focal neurologic deficits, and altered mentation are all specific to HACE. Dizziness, headache, and vomiting can all be seen in AMS. Dyspnea is nearly universal in HAPE.

**136.8.** You are the doctor on a group expedition to Denali. Recently, some of the climbers have complained of headaches, dyspnea, nausea, and difficulty sleeping. At breakfast this morning, one of the climbers is noted to have difficulty speaking and some slurred speech, which he attributes to a restless night's sleep. What treatment is appropriate for this patient?

- A. 24 hours of rest before further ascent
- B. Acetazolamide
- C. Descent to lower altitude
- D. Nifedipine
- E. Oxygen

**Answer: C.** This patient has high-altitude cerebral edema (HACE). Any hard neurologic finding (ataxia, slurred speech, focal neurologic deficits, seizure, or altered mentation) at altitude is indicative of HACE. Unlike acute mountain sickness (AMS) or high-altitude pulmonary edema (HAPE), which can occasionally be treated without descent, descent is mandatory for all cases of HACE. Dexamethasone should also be given to all patients with HACE. The other treatments mentioned are all possible treatments for HAPE.

**136.9.** You are the doctor on a group expedition to Denali and are currently at an elevation of 10,000 feet. One of the members of the group experiences headache, lightheadedness, and nausea. You diagnose him with acute mountain sickness (AMS) and treat him with acetazolamide and oxygen. He wants to know when he can continue climbing the mountain. What do you tell him?

- A. You may ascend if your oxygen saturation (as measured by pulse oximetry) is higher than 90%.
- B. You may ascend when all your symptoms resolve.
- C. You may never ascend any higher than this altitude.
- D. You may not ascend any higher on this expedition but may try again in 1 or 2 months.
- E. You may only sleep 1000 feet higher than your current altitude.

**Answer: B.** Management of AMS must adhere to the axiom, "After the symptoms of altitude illness occur, further ascent to a higher sleeping altitude is contraindicated."

increased public awareness of preventive measures and an emphasis on public education with regard to CPR and the dangers of ethanol use in conjunction with water-related activities are contributing significantly to the reduction in fatalities, in some locations by over 80%.

Parental education about the danger of pediatric drowning is an important focus of preventive efforts. Inadequate supervision of children playing in or near water is one of the most common causes of pediatric submersion death, underscoring the importance of increasing awareness of the need for constant oversight of children in this setting. Most pediatric submersion injuries in swimming pools occur at the victim's home. In most cases, the child is last seen in the house, is left unattended for a moment, and enters the pool on an unfenced side closest to the home with no audible splash or screaming. Adequate and fully circumferential fencing of residential pools is a current recommendation of the American Academy of Pediatrics (AAP). Drowning or submersion is 3.7 times more likely in a non-fenced pool than in a properly fenced pool. In Australia, safety legislation is associated

with a 30% reduction in drowning rates in young children. Unfortunately, legislation requiring appropriate fencing is poorly adhered to, and only 40% of households are compliant.

Legislation requiring personal floatation device usage in recreational boaters in Australia resulted in a significant decrease in drowning deaths.<sup>10</sup>

Effective approaches to prevention efforts in low- and middle-income countries differ from those in high-income countries. Data from almost 100,000 children in Bangladesh either entered into swim lessons or kept in a common supervision area in the community showed relative risks of drowning of 0.072 and 0.181, respectively. Both interventions were found to be extremely cost effective.<sup>11</sup>

Medical care providers are a vital resource for enhancement of public awareness of the importance of these measures. The literature supports the concept that education in the ED about drowning prevention can have a positive impact on patient and family awareness of steps to lessen the likelihood of catastrophic drowning injury.

*The references for this chapter can be found online by accessing the accompanying Expert Consult website.*



## KEY CONCEPTS

- Drowning is a leading cause of death and loss of years of life with over 90% of cases occurring in lower- and middle-income countries. Cost-effective prevention strategies have been developed for settings where resources limit treatment for drowning victims.
- All significant drownings induce pulmonary injury and hypoxia by the amount of water aspirated and the duration of submersion.
- Pulmonary and neurologic support is essential to optimize the victim's chance of a favorable outcome from this hypoxic event.
- Electroencephalography may be indicated in obtunded drowning victims to assess for subclinical seizures.
- No prognostic scale or clinical presentation accurately predicts long-term neurologic outcome; normal neurologic recovery is documented in patients with prolonged submersions, persistent coma, cardiovascular instability, and fixed and dilated pupils.
- Hyperventilation, steroids, dehydration, barbiturate coma, and neuromuscular blockade do not improve outcome after resuscitation.
- Comatose patients who have been resuscitated after reasonable submersion time regardless of rhythm should not be rewarmed above 34° C.

## CHAPTER 137: QUESTIONS &amp; ANSWERS

**137.1.** Which of the following is the greatest risk factor for death from drowning?

- A. Ethanol
- B. Male gender
- C. Poor swimming ability
- D. Saltwater drowning
- E. Warm water

**Answer: A.** Ethanol is a major risk factor for drowning and for death from drowning. Ethanol is a contributing factor in up to 50% of drowning incidents among adolescents and adults. More males drown than females, but male gender alone does not increase the risk of death from drowning. No direct evidence exists relating swimming ability to risk of death from drowning. Although frequently cited in older literature, there is no significant difference between saltwater and freshwater drowning. Although case reports of good survival from cold-water drowning exist, overall mortality is greater in cold water than in warm water.

**137.2.** A 13-year-old boy is brought to the emergency department (ED) after an apparent drowning. Family and paramedics report the patient was submerged for approximately 4 minutes. Bystanders began cardiopulmonary resuscitation (CPR) immediately. Paramedics intubated the patient and continued CPR, which has now been ongoing for 10 minutes. On arrival in the ED, the patient has a Glasgow Coma Score (GCS) of 3, unreactive pupils, no pulse, and is in asystole on the cardiac monitor. What is the most appropriate next step?

- A. Cessation of treatment/pronounce death
- B. External cardiac pacing
- C. Induction of hypothermia
- D. Intravenous epinephrine
- E. Unsynchronized defibrillation

**Answer: D.** Although this patient will likely have a poor outcome, asystolic victims of drowning have a higher incidence of full neurologic recovery than patients with asystole from other causes. Poor prognostic indicators are age younger than 3 years old, submersion greater than 5 minutes, delay in initiation of CPR greater than 10 minutes, hypothermia, severe acidosis, unreactive pupils, GCS of 3, and asystole. The decision to cease care must be made on a case-by-case basis, but initial treatment of asystole should be begun in drowning victims following standard advanced cardiac life support (ACLS) protocols. Experiments with induction of hypothermia are ongoing in drowning victims, but the results are not definitive.

**137.3.** A 16-year-old boy presents with tachypnea and coughing. Family members state that they were swimming in a nearby lake when they noticed the patient with the previously mentioned symptoms. The patient is awake

and alert but in obvious distress. He has a respiratory rate of 35 breaths per minute, with the remainder of his vital signs within normal limits. His oxygen saturation as measured by pulse oximetry is 84% while on high-flow oxygen. Pulmonary examination reveals diffuse rales. There is no evidence of trauma. In addition to intubation, which of the following is indicated?

- A. Administer intravenous diuretics.
- B. Administer intravenous steroids.
- C. Obtain an electrocardiogram (ECG).
- D. Perform maneuvers to remove fluid from the lungs.
- E. Place the patient in cervical spine precautions.

**Answer: C.** Dysrhythmias are frequently associated with drowning, especially when no obvious cause is found. ECGs should be performed on all drowning patients. Antibiotics, steroids, and diuretics have all been studied in drowning victims, and none show any benefit. Cervical spine precautions are often initiated in all drowning victims but are not needed unless the patient has clinical signs of trauma or a history of motor vehicle crash, fall from height, or diving into the water. Maneuvers to remove fluid from the lungs (Heimlich, Patrick) are ineffective and potentially dangerous.

**137.4.** An 18-year-old man is brought to the emergency department (ED) after submersion in his swimming pool. Per witnesses, once the patient was brought from the water, he initially had severe coughing and complained of shortness of breath. On arrival to the ED, the patient denies shortness of breath and is not coughing. Vital signs as well as oxygen saturation are all within normal limits. Electrocardiogram (ECG) and chest radiographs are normal. What is the appropriate disposition of this patient?

- A. Admission to telemetry for 23-hour observation
- B. Admission to the general hospital for 23-hour observation
- C. Admission to the intensive care unit for 23-hour observation
- D. Discharge home after observation in the ED for 6 hours
- E. Discharge home now

**Answer: D.** Any symptomatic patients or patients with a history of apnea, unconsciousness, or hypoxia should be admitted. Likewise, patients with dysrhythmias or abnormal chest radiographs should be admitted. Some effects of drowning can be delayed, so asymptomatic patients should be observed for 6 hours in the ED but can be safely discharged if they continue to be asymptomatic and can maintain normal room air oxygen saturation. They should be discharged in the care of a responsible family member or friend.

## KEY CONCEPTS

- Patients contaminated with radiation pose very little risk to health care providers when appropriate precautions and decontamination procedures are employed.
- Decontamination should not delay or impede the stabilization of patients in radiation emergencies.
- Tissues with greater rates of cellular division, particularly the hematopoietic and gastrointestinal systems, are most radiosensitive.
- Vomiting and skin burns occurring shortly following radiation exposure are predictors of severe radiation injury.
- The 48-hour absolute lymphocyte count is the most important prognostic indicator and should be drawn on suspected radiation exposure patients.
- Most therapy is supportive and symptomatic except for exposures involving the ingestion or inhalation of radioactive material, when specific therapy with blocking or chelating agents may be indicated.
- Formal consultation at the hospital, regional, and national levels is available 24 hours a day and should be used for assistance when any patient with radiation injuries is evaluated.

## CHAPTER 138: QUESTIONS &amp; ANSWERS

**138.1.** In the event of a nuclear power accident, which of the following radionuclides is most likely to pose the greatest hazard to the population living downwind from the reactor?

- A. Carbon 14
- B. Cobalt 60
- C. Iodine 131
- D. Plutonium 239
- E. Uranium 235

**Answer C.** The radioisotopes most commonly released from nuclear reactor accidents include iodine, cesium, and strontium. Release of radioiodine from the Chernobyl reactor resulted in several thousand cases of thyroid cancer among the exposed population.

**138.2.** A worker in your hospital's blood bank comes into the emergency department (ED) complaining that he has been exposed to radiation on an ongoing basis for approximately 1 month. He reports his job duties include irradiating blood products to be used in the hospital and that he has not been wearing protective clothing. He reports a burning sensation in his hands. His physical examination is normal. What is the appropriate course of action?

- A. Admit for observation
- B. Decontaminate the patient, admit for observation
- C. Decontaminate the patient, discharge home
- D. Decontaminate the patient, place on isolation, admit for observation
- E. Educate patient and arrange appropriate follow-up

**Answer: E.** This patient has been irradiated but not contaminated. Patients who are exposed to external beam radiation are not made radioactive and are not a hazard to others. Decontamination and isolation are not necessary. With a normal physical examination and minimal symptoms, this patient can be followed as an outpatient. The most important action in this instance is to educate the patient.

**138.3.** What is the most important laboratory test to be performed 48 hours after exposure in determining the prognosis of a patient exposed to a significant radiation source?

- A. Absolute lymphocyte count
- B. Absolute neutrophil count
- C. Karyotype
- D. Platelet count
- E. Serum albumin

**Answer: A.** Monitoring the kinetics of lymphocyte depletion during the first 48 hours following a radiation exposure is very useful at estimating the radiation dose received. The 48-hour absolute lymphocyte count is the most important prognostic indicator and should be drawn on all suspected radiation exposure patients. Levels greater than 1200/ $\mu$ L indicate a clinically insignificant dose of radiation and an excellent prognosis. Levels less than 500/ $\mu$ L indicate a significant and possible lethal exposure. None of the other answer choices carry prognostic significance.

**138.4.** What organ system is the first to show signs and symptoms following a significant radiation exposure?

- A. Central nervous
- B. Dermatologic
- C. Gastrointestinal
- D. Genitourinary
- E. Hematopoietic

**Answer: C.** The first signs and symptoms of acute radiation injury are nausea and vomiting. An earlier onset of symptoms indicates more severe exposure. Typically, exposure to a radiation dose of at least 1 Gy is necessary to produce symptoms.

**138.5.** A 45-year-old man is accidentally exposed to a radiation field of 850 mSv/hour for 4 hours while working on the clean-up of a nuclear power plant accident. Other than general supportive care, which of the following medications may improve his survival?

- A. Acyclovir
- B. Colony-stimulating factor (cytokines)
- C. diethylenetriaminepentaacetate (DTPA)
- D. Erythropoietin
- E. Potassium iodide

**Answer: B.** This patient's radiation dose is sufficient to produce the hematopoietic component of acute radiation syndrome (ARS). Cytokines or colony-stimulating factors have shown modest effects in improving survival. Irradiated patients may develop oral herpes, and acyclovir can be used for treatment but does not affect survival. Anemia is present in most irradiated patients but is usually not clinically significant, and erythropoietin has no role. DTPA is a chelating agent that can be used for patients with internal exposure to plutonium or transuranics. Potassium iodide is useful if a patient is exposed to radioactive iodine, because it will compete with the radioactive iodine for uptake into the thyroid gland, resulting in overall less radioactive uptake.

**138.6.** What type of radiation event is most likely to cause incorporation and internal contamination?

- A. A portable x-ray machine
- B. Detonation of a dirty bomb
- C. Fluoroscopy
- D. Proton-beam radiotherapy
- E. Solar flare

**Answer: B.** A dirty bomb is the combination of a conventional explosive with a radioisotope illegally obtained from medical or industrial sources. Dispersal of the radioisotope is likely to produce incorporation of the radioisotope through inhalation and inadvertent ingestion. The other radiation sources listed result in external radiation.

## KEY CONCEPTS

- Toxidromes are constellations of signs and symptoms based primarily on vital signs and neuropsychiatric functions that are characteristic manifestations of certain toxic exposures. Recognition of the presence of a toxidrome can suggest a potential intoxicant and guide early interventions and management strategies. Examples of toxidromes include sympathomimetic, antimuscarinic, cholinergic, sedative-hypnotic, and opioid categories.
- Qualitative urine drug are inferior to quantitative serum levels in terms of guiding specific therapy.
- Syrup of ipecac is not indicated in the ED care of a poisoned patient. Gastric lavage is not part of routine care. When given in a timely fashion (1 hour post ingestion), activated charcoal may be indicated for potentially lethal agents in alert, cooperative patients as noted in [Figure 139.1](#). Whole-bowel irrigation is rarely useful for management of poisoned patients but is potentially helpful for specific poisonings, such as metals, illicit drug packets, or sustained-release medications.
- Serum alkalinization enhances urinary drug elimination for certain drugs and is indicated for significant poisoning caused by salicylates, phenobarbital, and methotrexate.
- Hemodialysis is best suited to remove poisons of low molecular weight, low protein binding, and high water solubility; examples include methanol, ethylene glycol, lithium, and salicylates.
- Regional Poison Control Centers 1-800-222-1222 or a medical toxicologist can assist with antidotal therapy and may help facilitate patient disposition.
- If the motivation behind the toxic exposure was self-harm, a psychiatric consultation is warranted.

## CHAPTER 139: QUESTIONS &amp; ANSWERS

- 139.1.** A 23-year-old man presents with confusion. His vital signs are blood pressure 105/77 mm Hg, heart rate 69 beats per minute, respiratory rate 10 breaths per minute, temperature 37.0° C, and arterial oxygen saturation (SaO<sub>2</sub>) 96% on 2 L NC. His eyes open only to pain, he localizes to pain, but he does not follow commands and his speech is confused. Otherwise, his physical examination is normal. After intravenous (IV) access is obtained and he is placed on continuous cardiac monitoring, what is the most appropriate next step?
- Check arterial blood gases (ABG).
  - Check bedside serum glucose.
  - Give 50% dextrose 1 amp IV.
  - Give naloxone 2 mg IV.
  - Perform electrocardiogram (ECG).

**Answer: B.** All patients with altered mental status should have a rapid determination of their glucose. Although this patient has several abnormal vital signs, none necessitate immediate action. His Glasgow Coma Score (GCS) is 11, and it appears that his respiratory status is adequate. Dextrose should not be given unless hypoglycemia is documented. Naloxone is an opioid antagonist, and it could reverse the patient's confusion if it is caused by opioids. This drug could be considered once other more easily reversible causes of confusion (eg, hypoglycemia) have been ruled out. ABG and ECG are both occasionally needed in patients with altered mental status, but neither is as urgent as glucose testing.

- 139.2.** The odor on a poisoned patient can provide clues as to the substance causing the poisoning. If a patient smells of garlic, what should you be concerned about?
- Cyanide
  - Hydrogen sulfide
  - Methyl salicylate
  - Organophosphates
  - Toluene

**Answer: D.** Arsenic, dimethyl sulfoxide (DMSO), yellow phosphorus, selenium, and tellurium can also have a garlic odor. Odors associated with the other answer choices are as follows: cyanide, bitter almonds; hydrogen sulfide, rotten eggs; methyl salicylate, wintergreen; and toluene, glue. Odors can aid in making the diagnosis but should not be relied on as completely diagnostic. Also, the lack of odors cannot be used to rule out a poisoning resulting from that substance.

- 139.3.** A 17-year-old girl presents with delirium, tachycardia, dry skin, flushed face, decreased bowel sounds, dilated pupils, and urinary retention. A friend states that the patient had recently ingested some unknown medications in a suicide attempt. Which of the following medications is most likely responsible for the constellation of signs?
- Alprazolam
  - Clonidine
  - Diphenhydramine
  - Hydrocodone
  - Pseudoephedrine

**Answer: C.** The patient is expressing the signs of classic antimuscarinic poisoning. Central nervous system (CNS) effects include the delirium and typical "picking movements" of the fingers. Suppression of the cholinergic system results in tachycardia. All secretory functions are inhibited, causing the dry, flushed skin, decreased bowel sounds, and urinary retention. Unopposed sympathetic activity results in dilated pupils. Alprazolam, clonidine, and hydrocodone can all cause the sedative toxidrome. Pseudoephedrine can lead to the sympathomimetic toxidrome, which typically has diaphoretic skin but can otherwise appear similar to an anticholinergic presentation.

- 139.4.** What is the elimination half-life of naloxone?
- 30 minutes
  - 1 hour
  - 2 hours
  - 4 hours
  - 6 hours

**Answer: B.** The exact elimination half-life of naloxone is closer to 1.1 hours (1 hour 6 minutes). This is markedly shorter than the half-life of almost all opioids. For comparison, morphine has a half-life of approximately 2 hours, hydrocodone has a half-life of approximately 4 hours, and methadone has a half-life up to 30 hours. This means that repeat dosing of naloxone is often necessary when treating opioid overdose. A drug similar in action to naloxone, nalmefene, has a half-life of 10 hours and may sometimes be useful.

**139.5.** You suspect a patient has a cholinergic syndrome. Which of the following, if found, would make you question your diagnosis?

- A. Confusion
- B. Diaphoresis
- C. Diarrhea
- D. Fasciculations
- E. Mydriasis (dilated pupils)

**Answer: E.** The typical cholinergic patient is “wet.” A common mnemonic used to remember the symptoms is SLUDGE—salivation, lacrimation, urination, defecation, gastrointestinal cramping, and emesis. Confusion can be present but is nonspecific. Frequently, cholinergic syndrome is caused by organophosphate poisoning, so fasciculations are common. Another common sign is miosis, not mydriasis.

**139.6.** Gastric decontamination with activated charcoal can decrease the absorption of certain toxins. However, before charcoal can be given, it must be determined that the risk of aspiration is low, the likelihood of reduction of toxicity or improved patient outcome is high, and that the ingestion occurred recently (within approximately 1 hour). Also, it must be determined that the substance ingested is actually adsorbed by charcoal. Which of the following substances is adsorbed by charcoal?

- A. Gasoline
- B. Hydrofluoric acid
- C. Iron
- D. Methanol
- E. Metoprolol

**Answer: E.** Charcoal does not adsorb hydrocarbons (ie, gasoline), ionic substances (ie, strong acids or bases), metals (ie, iron), or alcohols. It does adsorb most therapeutic drugs with potential major toxicity, such as beta-blockers, calcium channel blockers, and cyclic antidepressants.

**139.7.** A 6-year-old boy is found playing with liquid pesticide by family members. The family states that he was drinking the solution. Paramedics find the child sitting in a puddle of liquid that smells strongly of pesticide. He is acting normally. En route to the hospital, the paramedics report that the child is now sleepier than previously but still easily aroused with a loud voice. His vital signs are within normal limits. They ask what they should do next. What do you advise?

- A. Administer IV atropine
- B. Administer oral activated charcoal
- C. Administer naloxone
- D. Perform rapid sequence intubation
- E. Remove the child’s clothing and wash the skin

**Answer: E.** This child’s clothing has been impregnated with poison, and as long as the child is clothed, he will continue to absorb the poison. Ideally, all patients should be decontaminated on scene to expedite decontamination as well as to minimize the risk of contaminating others. Although this child may have ingested some poison, it is likely that far more is being absorbed from his skin than through his gastrointestinal tract. In addition, charcoal can cause complications, whereas removal of contaminated clothing is relatively safe. Although this child may eventually require intubation, he does not need it now. Most pesticides are organophosphates, so this patient may require atropine, but removal from the poison (taking off his clothing) will provide the greater immediate impact on his condition.

**139.8.** A patient suffering from serotonin syndrome will experience myriad physiologic abnormalities, including altered mental status, fever, agitation, tremor, and myoclonus. Many of the symptoms are nonspecific. Which of the following diagnoses is often mistaken for serotonin syndrome?

- A. Anticholinergic syndrome
- B. Brown recluse envenomation
- C. Opioid withdrawal
- D. Sepsis
- E. Sympathomimetic overdose

**Answer: E.** Serotonin syndrome is characterized by altered mental status, fever, agitation, tremor, myoclonus, hyperreflexia, ataxia, incoordination, diaphoresis, shivering, and diarrhea. Similar symptoms are seen with overdoses of sympathomimetics, lithium, and monoamine oxidase inhibitors (MAOIs). Similar symptoms are also seen with neuroleptic malignant syndrome (NMS) and malignant hyperthermia. The antimuscarinic syndrome will give a “dry” patient without diaphoresis. Brown recluse envenomation produces local pain and possibly skin necrosis, as well as systemic symptoms of fever, nausea, and vomiting. Opioid withdrawal produces similar symptoms and will cause myalgias but without other musculoskeletal effects. Sepsis likewise can produce many of the systemic signs and symptoms seen in serotonin syndrome but without the musculoskeletal effects.

## KEY CONCEPTS

- Substance abuse can affect people from all socioeconomic groups and all ages.
- For the majority of patients with toxin-induced violent behavior, intramuscular butyrophenones (such as, haloperidol) are safe and rapidly effective sedating agents. With suspected sympathomimetic (eg, cocaine and amphetamines) intoxication, benzodiazepines (such as, lorazepam) should be used.
- Presentation to an ED with a complication of substance abuse may be a “teaching moment.” Substance abusers should be offered drug treatment services.

## CHAPTER 140: QUESTIONS &amp; ANSWERS

**140.1.** The toxic syndrome for anticholinergic overdose is similar to sympathomimetic toxicity and includes all of the following signs with the exception of:

- A. Altered mental status
- B. Diaphoresis
- C. Hyperthermia
- D. Increased heart rate
- E. Urinary retention

**Answer: B.** Anticholinergic (antimuscarinic) syndrome includes all of the signs above except for diaphoresis. Typically, anticholinergic poisoning presents with dry skin and mouth but otherwise has similar features to sympathomimetic toxicity. Sympathomimetic overdose often presents with diaphoresis. Anticholinergic patients are also less paranoid and violent.

**140.2.** What percentage of emergency department (ED) patients are in need of substance abuse treatment?

- A. 1%
- B. 10%

- C. 25%
- D. 50%
- E. 75%

**Answer: C.** Approximately 1% of ED patients have a formerly recorded diagnosis of substance abuse, but about 25% are actually in need of substance abuse treatment. Many patients are in denial about their dependency or hiding their substance abuse problems and will avoid talking about this. Because substance abuse increases the risk for injury or illness, these patients are at much higher risk for the need for emergency care than the general population.



## KEY CONCEPTS

- Serum osmolality is calculated by the following equation:

$$\text{Calculated osmolality (mOsm/kg)} = 2\text{Na}^+ + (\text{BUN}/2.8) + (\text{glucose}/18) + (\text{ethanol}/4.6)$$

The measured osmolar gap is the difference between the measured serum osmolality and calculated serum osmolality, with a normal range of  $-15$  to  $+10$  mOsm.

- The classic finding of an elevated osmolar and anion gap should raise suspicion of methanol or ethylene glycol toxicity but may not be present, depending on the timing of ingestion. Early ingestion has a high osmolar gap without acidosis, and late ingestion has acidosis without an osmolar gap.
- A normal osmolar gap does not exclude toxic alcohol ingestion.
- Initiate therapy based on clinical suspicion of exposure to methanol or ethylene glycol. Block alcohol dehydrogenase preferably with fomepizole, but ethanol can be used if fomepizole is unavailable.
- The presence of acidosis indicates accumulation of the toxic metabolites of methanol (formic acid) and ethylene glycol (glycolic and oxalic acid). Consult nephrology for emergent hemodialysis to correct acid-base disturbances and remove the parent compound and its toxic metabolites.
- Severe acidosis is a poor prognostic factor, with high mortality rates in methanol and ethylene glycol ingestions. A comatose state at time of presentation also is associated with a higher mortality outcome.
- The main priorities in toxic alcohol exposure are correction of acidosis using bicarbonate solution and hemodialysis, inhibition of the production of toxic metabolites, and elimination of the parent alcohol and its toxic metabolites.
- The findings of an elevated osmolar gap with ketonemia or ketonuria and no development of acidosis indicates isopropanol ingestion. Patients can have a prolonged period of inebriation and can be comatose. Alcohol dehydrogenase inhibition is not indicated in these cases.
- Hypotension and GI bleeding are poor prognostic factors in isopropanol ingestion.
- Diethylene glycol can result in acidosis and renal failure and should be managed similarly to ethylene glycol poisoning with fomepizole and early hemodialysis.

## CHAPTER 141: QUESTIONS &amp; ANSWERS

**141.1.** A 24-year-old man presents after an intentional methanol ingestion. The patient reports that 1 or 2 hours ago he drank approximately 8 ounces of windshield washer fluid in a suicide attempt. He is not sure of the product name. His only current complaint is slight nausea. His vital signs and physical examination are within normal limits. Serum chemistry reveals the following: sodium, 142 mEq/L, potassium, 4.5 mEq/L, chloride, 110 mEq/L, bicarbonate, 22 mEq/L, blood urea nitrogen (BUN), 18 mg/dL, creatinine, 1.5 mg/dL, and glucose, 111 mg/dL. Serum methanol levels are not obtainable at your hospital. The psychiatry service asks if the patient is medically cleared. Which of the following is the most appropriate response?

- The patient is cleared; he has a normal anion gap, so no significant methanol ingestion occurred.
- The patient is cleared; ingestion of 8 ounces is below the toxic level regardless of the concentration.
- The patient is not cleared; he has an elevated anion gap and needs to receive treatment for methanol toxicity.
- The patient is not cleared; he has evidence of renal failure and needs to receive treatment for methanol toxicity.
- The patient is not cleared; not enough time has elapsed from the ingestion to determine if significant toxicity has occurred.

**Answer: E.** Windshield washer fluid can contain high concentrations of methanol. Methanol itself does not cause toxicity or an anion gap acidosis but its metabolites do, specifically formic acid. It can take 12 to 24 hours for acidosis to develop and even longer if a significant amount of ethanol has also been ingested. This patient should be observed and treated. This patient's anion gap is 10 mEq/L, which is within normal limits. Ingestion of very small amounts of methanol can be fatal or cause permanent neurologic or ophthalmologic damage. As little as 15 mL of 40% methanol can cause death in adults.

**141.2.** A 44-year-old woman complains of abdominal pain and headache. Her family reports that the patient drank "something" approximately 8 hours ago in a suicide attempt. The patient is sleepy but arouses with manual stimulation. Her speech is confused, but she follows all simple commands. Her vital signs are blood pressure,

124/82 mm Hg, heart rate, 108 beats/min, respiratory rate, 26 breaths/min, and temperature, 37.0°C (98.6°F). Her physical examination is unremarkable. Her serum chemistry reveals an anion gap of 24 mEq/L. Other laboratory work is pending. Which of the following treatments should be administered initially?

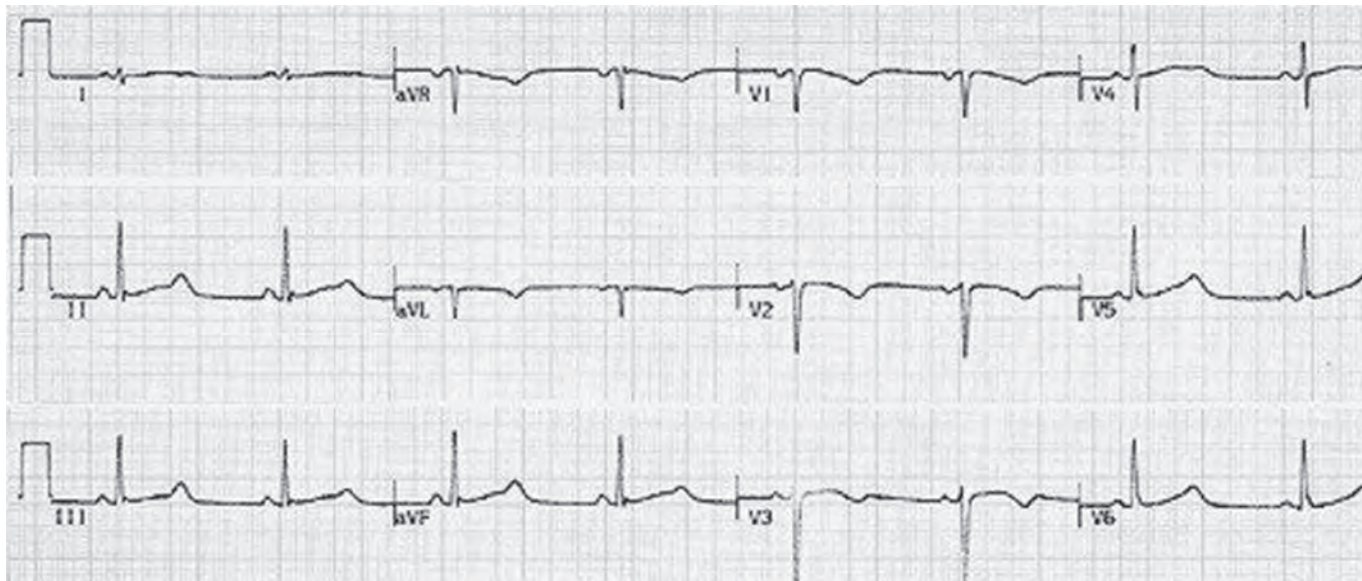
- Diuresis
- Hemoperfusion
- Intravenous flumazenil
- Intravenous fomepizole
- Oral activated charcoal

**Answer: D.** Intravenous fomepizole should be administered. This patient has likely ingested methanol or ethylene glycol, both of which can cause these symptoms, as well as an anion gap metabolic acidosis. The definitive treatment for both ingestions is hemodialysis, which can take some time to arrange. Treatment should be started with fomepizole, even before a definitive diagnosis has been made. Fomepizole and ethanol act by inhibiting the conversion of methanol or ethylene glycol to toxic substances, thereby allowing elimination of the much less toxic original compounds. Diuresis and hemoperfusion are not effective for methanol or ethylene glycol. Flumazenil will reverse the effect of benzodiazepine but should always be used with caution so as not to induce seizure activity. Oral charcoal is not effective for methanol or ethylene glycol, especially after such a long delay.

**141.3.** A 20-year-old man presents after ingesting antifreeze. His electrocardiogram (ECG) is shown below. Which electrolyte abnormality is most likely responsible for the findings on the ECG?

- Hypercalcemia
- Hyperkalemia
- Hypocalcemia
- Hypokalemia
- Hypomagnesemia

**Answer: C.** Hypocalcemia is a cause of QT prolongation. Ingestion of ethylene glycol can result in hypocalcemia, which is caused by calcium precipitation with oxalate. Although ethylene glycol ingestion can result in renal failure that can then cause hyperkalemia, it is not associated with QT prolongation. Hypokalemia and hypomagnesemia can both cause QT prolongation; neither is associated with ethylene glycol ingestion.



**141.4.** An otherwise healthy patient presents after a suicidal ethylene glycol ingestion. He is drowsy. His serum pH is 7.1. You have started treatment with fomepizole and have contacted the nephrologist to arrange dialysis. In the meantime, what should be done about the patient's acidosis?

- A. Normal saline should be administered to facilitate clearance of the acid.
- B. Nothing should be done; dialysis will correct the acidosis.
- C. Nothing should be done; the fomepizole will correct the acidosis.
- D. Nothing should be done; the patient is not truly acidotic, but ethylene glycol interferes with the laboratory determination of pH.
- E. Sodium bicarbonate should be administered to neutralize the exogenous acid.

**Answer: E.** Unlike lactic acid, which will be metabolized to bicarbonate, the acidic metabolites of methanol and ethylene glycol cannot be metabolized to bicarbonate and can cause a severe acidosis if not treated. Dialysis will correct the acidosis, but early treatment of the acidosis can reverse some of the adverse effects of methanol or ethylene glycol poisoning. Fomepizole prevents the conversion of methanol or ethylene glycol into toxic metabolites but does nothing to the metabolites already produced. Forced saline diuresis is not beneficial and may increase the incidence of acute respiratory distress syndrome.

**141.5.** Which of the following is an indication for hemodialysis after methanol or ethylene glycol ingestion?

- A. Acidosis
- B. Blood level of 10 mg/dL
- C. Elevated anion gap
- D. Hypocalcemia
- E. Hypokalemia

**Answer: A.** Metabolic acidosis, renal compromise, visual symptoms, deterioration despite intensive supportive care, and electrolyte abnormalities unresponsive to conventional therapy are all indications for hemodialysis. Although an anion gap is often associated with metabolic acidosis, an anion gap in and of itself is not an indication for hemodialysis. There is debate about the alcohol levels that indicate the need for hemodialysis.

Recommendations have been made to dialyze patients with levels of methanol or ethylene glycol between 25 and 50 mg/dL.

**141.6.** Which of the following cofactors helps with the elimination of methanol and should be given to patients with methanol poisoning?

- A. Folate (vitamin B<sub>9</sub>)
- B. Hydroxocobalamin (vitamin B<sub>12</sub>)
- C. Niacin (vitamin B<sub>3</sub>)
- D. Pyridoxine (vitamin B<sub>6</sub>)
- E. Thiamine (vitamin B<sub>1</sub>)

**Answer: A.** Folate is a cofactor in the degradation of formic acid to carbon dioxide and water, the final step in the metabolism of methanol. Folinic acid is recommended to be given 50 mg IV every 4 hours to adults with methanol poisoning. Thiamine and pyridoxine are both useful for patients with ethylene glycol poisoning and should be given. Niacin and hydroxocobalamin are antidotes but play no role in treatment for ethanol or ethylene glycol poisoning.

**141.7.** Which of the following statements comparing the effects of isopropyl alcohol and ethylene glycol is true?

- A. Isopropyl alcohol causes less CNS depression and is less toxic than ethylene glycol.
- B. Isopropyl alcohol causes less CNS depression and is more toxic than ethylene glycol.
- C. Isopropyl alcohol causes more CNS depression and is less toxic than ethylene glycol.
- D. Isopropyl alcohol causes more CNS depression and is more toxic than ethylene glycol.
- E. Isopropyl alcohol has the same effects as ethylene glycol.

**Answer: C.** Isopropyl alcohol causes twice the central nervous system (CNS) depression of ethanol, which causes more depression than ethylene glycol. Isopropyl alcohol is metabolized to acetone, which also causes CNS depression but is relatively non-toxic, except in very high doses.

**141.8.** A patient presents with decreased mental status after drinking some homemade alcohol. Serum chemistry reveals sodium, 140 mEq/L, potassium, 4.5 mEq/L, chloride, 108 mEq/L, bicarbonate, 22 mEq/L, BUN,

28 mg/dL, creatinine, 1.0 mg/dL, glucose, 90 mg/dL, and serum osmolality, 320 mOsm/kg. Urinalysis is positive for ketones. Which of the following is the most likely alcohol ingested?

- A. Ethanol
- B. Ethylene glycol
- C. Isopropyl alcohol
- D. Methanol

E. On the basis of this information, the patient probably did not ingest an alcohol.

**Answer: C.** This patient has a normal anion gap of 10 but an elevated osmolal gap of 25. The osmolal gap equals the measured

serum osmolality minus the calculated serum osmolality. The calculated osmolality is

$$(\text{Sodium} \times 2) + (\text{BUN}/2.8) + (\text{glucose}/18)$$

In this case, it is 295 mOsm/kg. Ethylene glycol and methanol both cause a double gap or elevated anion and osmolal gaps. Ethanol and isopropyl alcohol generally elevate only the osmolal gap. Isopropyl alcohol ingestion causes more CNS depression than ethanol ingestion and results in ketonemia and ketonuria as it is metabolized to acetone.

## KEY CONCEPTS

- Moderate alcohol consumption is defined as one or two drinks/day for men and one drink/day for women.
- Benzodiazepines are the main treatment of alcohol withdrawal and alcohol withdrawal seizures. Minor alcohol withdrawal occurs as early as 6 hours and usually peaks at 24 to 36 hours after the cessation of or significant decrease in alcohol intake.
- Major alcohol withdrawal occurs after 24 hours and usually peaks at 50 hours (but occasionally takes up to 5 days) after the decrease or termination of drinking.
- Delirium tremens is the extreme end of the alcohol withdrawal spectrum; it consists of gross tremors, profound confusion, fever, incontinence, and frightening visual hallucinations.
- Alcohol withdrawal seizures occur 6 to 48 hours after the cessation of drinking, with 60% of patients experiencing multiple seizures within a 6-hour period.
- Alcohol withdrawal should be assessed and managed using a validated scale, such as the CIWA-Ar scale.

## CHAPTER 142: QUESTIONS &amp; ANSWERS

**142.1.** A 56-year-old man presents with altered mental status. You recognize the patient as a frequent visitor to the emergency department (ED) for alcohol intoxication. He is drowsy but arousable to painful stimuli. He is confused. Vital signs are within normal limits, and there is no evidence of trauma. His blood glucose level is 30 mg/dL. Which treatment is indicated first?

- A. Dextrose
- B. Folate
- C. Glucagon
- D. Naloxone
- E. Thiamine

**Answer: A.** Although alcohol intoxication clearly causes altered mental status (AMS), it should never be assumed that AMS is due to alcohol intoxication. Alcoholics are at risk for multiple medical and traumatic causes of AMS. Chronic alcoholics have decreased glycogen stores and frequently experience hypoglycemia. Because glucagon works by mobilizing glycogen stores, it is often not effective in alcoholics. Thiamine and folate stores are often depleted and can result in Wernicke's encephalopathy. However, hypoglycemia is much more common and can also result in permanent morbidity if untreated. Although the administration of thiamine and folate should be considered for alcoholics, their use should never delay treatment of hypoglycemia. Naloxone is an opioid antagonist and has no effect on alcohol metabolism or glucose levels.

**142.2.** A 62-year-old man presents with agitation, confusion, and fever. He is noted to experience visual hallucinations during your interview. His vital signs reveal hypertension, tachycardia, and fever. Physical examination is otherwise unremarkable. Diagnostic studies (including head CT and lumbar puncture) are nonspecific. Which diagnosis is most consistent with this patient's presentation?

- A. Acute schizophrenia
- B. Alcohol withdrawal

- C. Anticholinergic poisoning
- D. Opioid withdrawal
- E. Thyrotoxicosis

**Answer: B.** Patients are often confused and agitated and exhibit autonomic instability, resulting in hypertension, tachycardia and, often, fever. Hallucinations are typically visual. Schizophrenia typically results in auditory hallucinations and, although patients are delusional, they are not typically confused. Patients with anticholinergic poisoning typically present with confusion but also have dry mouth, dry eyes, dry skin, hypoactive bowel sounds, and urinary retention. Patients with opioid withdrawal typically have gastrointestinal complaints and, although they may be agitated, they are seldom confused or febrile. Thyrotoxicosis is much more common in women, and patients can exhibit lid lag, tremor, and gastrointestinal complaints.

**142.3.** In addition to altered mental status (AMS), which of the following is a criterion for diagnosing Wernicke's encephalopathy?

- A. Alcohol intoxication
- B. Fever
- C. Oculomotor abnormalities
- D. Recent glucose administration
- E. Seizure

**Answer: C.** Criteria to diagnose Wernicke's encephalopathy require two of the following: (1) dietary deficiencies; (2) oculomotor abnormalities; (3) cerebellar dysfunction; and (4) AMS or mild memory impairment. Although it is most often diagnosed in alcoholics, alcohol consumption is not required. Treatment is with replacement of dietary deficiencies, particularly thiamine. Magnesium levels should be checked and treated if low. Magnesium is a cofactor for thiamine and is often depleted in chronic alcoholics.

## KEY CONCEPTS

- Acetaminophen concentration should be measured in the vast majority of intentional oral overdoses. Acetaminophen is relatively clinically silent until serious hepatotoxicity ensues.
- Repeated supratherapeutic dosing of acetaminophen can lead to life-threatening toxicity.
- The acetaminophen concentration on the nomogram at 4 hours or more post-ingestion is used to determine whether NAC therapy is indicated for acute ingestions.
- IV NAC is preferable to PO NAC. When NAC is initiated, it is continued until the protocol is completed and there is no evidence of liver injury and clearance of acetaminophen. If there is evidence of liver injury or acetaminophen level remains  $>10 \mu\text{g/mL}$ , NAC is continued until acetaminophen is undetectable, clinical signs of liver injury have resolved, and liver enzymes are declining (AST  $<1000 \text{ IU/L}$ ).
- For maximum benefit, NAC treatment should not be delayed beyond 8 hours after ingestion. If more than 8 hours has passed since ingestion, treatment should be started with ongoing assessment of the amount of ingestion (with serial acetaminophen levels) and likelihood of hepatotoxicity (elevated transaminases, coagulopathy, and encephalopathy).
- Late or prolonged administration of NAC is beneficial even with low or absent acetaminophen concentrations if hepatotoxicity is evident.
- NAC is safe in pregnancy and is used in the same protocol as for the nonpregnant patient.

## CHAPTER 143: QUESTIONS &amp; ANSWERS

- 143.1.** Which of the following is true regarding pregnant patients with an acute acetaminophen ingestion?
- All pregnant women should be treated with *N*-acetylcysteine (NAC) after any known ingestion of acetaminophen
  - Pregnant women in the third trimester should be treated with NAC if their acetaminophen concentration is ever elevated above  $50 \mu\text{g/mL}$
  - Pregnant women should be treated with NAC if their acetaminophen concentration is above the Treatment Line on the nomogram
  - Pregnant women should be treated with NAC if they ingest  $>75 \text{ mg/kg}$  PO acetaminophen over less than 8 hours
  - The Treatment Line on the nomogram is lowered to a line starting at  $100 \mu\text{g/mL}$  at 4 hours after ingestion

**Answer: C.** Pregnant patients with an acute ingestion of acetaminophen should have the same initial treatment as nonpregnant patients. After measurement of an acetaminophen concentration, plotting of the acetaminophen concentration on the nomogram treatment with NAC should be given if the concentration is above the Treatment Line on the nomogram.

Both acetaminophen and NAC do cross the placenta, but the fetus is at risk only if the mother becomes ill. Patients with first trimester pregnancies are at risk of miscarriage if the mother becomes ill, and fetuses that are near-term may be at risk for fetal/neonatal hepatotoxicity.

- 143.2.** A 3-year-old boy with intractable vomiting and fever is treated with intravenous (IV) acetaminophen. He is given a tenfold dosing error ( $150 \text{ mg/kg}$  instead of  $15 \text{ mg/kg}$ ). Which of the following is one of the current criteria for treatment of his overdose?
- Treat with *N*-acetylcysteine (NAC) if the 4-hour acetaminophen concentration is above  $50 \mu\text{g/mL}$
  - Treat with NAC for any IV dose greater than  $15 \text{ mg/kg}$

- Treat with NAC for any IV dose greater than 4 grams
- Treat with NAC only if the 2-hour acetaminophen concentration is above the Treatment Line
- Treat with NAC only if the 4-hour acetaminophen concentration is above the Treatment Line

**Answer: A.** Although data is limited, the current recommendations for treatment with NAC of an IV acetaminophen overdose is (1) treat for any dose  $>60 \text{ mg/kg}$  or (2) treat if the 4-hour acetaminophen concentration is  $>50 \mu\text{g/mL}$ .

- 143.3.** A 30-year-old woman presents with drowsiness, nausea, and vomiting. She reports taking several pills in a suicide attempt. Despite your best efforts, she cannot describe what she ingested or how many she ingested. She states she took the pills “last night” and refuses to be more specific. Currently, it is 6 AM. A family member is present and found the patient vomiting at 4 AM, at which time she informed the family member she took some pills. The family member further states that the patient was in an argument with a friend at 12 PM and may or may not have ingested the pills at that time. The family was with the patient at 8 PM and is sure that she had not ingested the pills at that time. What time should be used as the time of ingestion?
- 2 AM—the time that is 4 hours prior to presentation
  - 4 AM—the time the patient was found abnormal
  - 6 AM—the time of presentation
  - 8 PM—the time the patient was last seen and known to be prior to the ingestion
  - 12 PM—the time the patient was last seen prior to becoming symptomatic

**Answer: D.** If the exact time of ingestion cannot be determined, then the “worst case” scenario should be assumed. The longer a patient goes without therapy, the worse the outcome. Therefore, the time of ingestion should be assumed to be the last time the patient was seen normal prior to any possible ingestion.



**143.4.** A 20-year-old man is brought to the emergency department by family with a complaint of “overdose.” The patient is drowsy but arousable. His vital signs are normal. His physical examination is normal except for appearing to be intoxicated. He has no complaints. The family reports the ingestion of unknown “pills” as well as alcohol and possibly “street drugs.” The ingestion occurred approximately 6 hours ago after an argument. Routine supportive care is initiated. What test must be ordered on this patient because it may affect the immediate treatment plan?

- A. Acetaminophen concentration
- B. Chest radiograph
- C. Head computed tomography (CT) scan
- D. Serum alcohol concentration
- E. Urine drug screen

**Answer: A.** The antidote is given as soon as possible after ingestion, but definitely within 8 hours to prevent toxicity.

**143.5.** What is the typical peak serum acetaminophen concentration after a therapeutic oral ingestion?

- A. Undetectable
- B. 10 µg/mL
- C. 30 µg/mL
- D. 50 µg/mL
- E. 100 µg/mL

**Answer: C.** This concentration is typically reached approximately 1 hour after ingestion. Four hours after a therapeutic ingestion, the concentration is typically less than 10 µg/mL. Concentrations higher than this should lead one to consider the possibility of chronic ingestion or a person who does not properly metabolize acetaminophen.

**143.6.** Two 20-year-old patients present to the emergency department 1 hour after ingesting 15 grams of acetaminophen each in a suicide pact. You are confident of the time of ingestion and that time is confirmed by text messages sent by the patients. Patient A has a 4-hour acetaminophen concentration of 130 mg/dL. Patient B’s 4-hour acetaminophen concentration is 170 mg/dL. What is the appropriate treatment for both patients?

- A. Neither patient requires treatment because the acetaminophen concentrations are below the treatment cutoff.
- B. Neither patient requires treatment because they received activated charcoal (AC).
- C. Patient A should receive immediate *N*-acetylcysteine (NAC); patient B should *not* receive NAC.
- D. Patient A should *not* receive NAC; patient B should receive immediate NAC treatment.
- E. Both patients should receive immediate NAC therapy.

**Answer: D.** In this case, your confidence of the time of ingestion is high. The Treatment Line crosses 150 mg/dL at 4 hours. Therefore, if the 4-hour acetaminophen concentration is >150 mg/dL, treatment is indicated. In the case above, patient A does not require NAC therapy, but patient B does require treatment with NAC.

**143.7.** What is the antidote for acetaminophen ingestion?

- A. Dimercaprol
- B. Hydroxycobalamin
- C. *N*-acetylcysteine (NAC)
- D. *N*-acetyl-*p*-benzoquinone imine (NAPQI)
- E. Succimer

**Answer: C.** Hydroxycobalamin is an antidote for cyanide; succimer is an antidote for lead; and dimercaprol is an antidote for arsenic, lead, and mercury. NAPQI is the toxic metabolite of acetaminophen.

**143.8.** A 42-year-old man presents to the emergency department with complaints of nausea and vomiting. He has no other complaints. His symptoms started approximately 12 hours ago. His history is significant for “back pain,” which has been worse than normal recently. He states that he finished a bottle of 60 “pain pills” during the past 2 days. His vital signs are normal. Other than right upper abdominal tenderness, his physical examination is normal. Routine laboratory tests including complete blood count, chemistry, and liver panel are normal except an aspartate transaminase (AST) concentration of 265 IU/L. You are concerned for possible repeated supratherapeutic acetaminophen poisoning. What should you do next?

- A. Admit the patient for observation and repeat AST testing; because this is a repeated supratherapeutic ingestion, treatment with *N*-acetylcysteine (NAC) is not beneficial.
- B. Initiate treatment with activated charcoal (AC) now.
- C. Initiate treatment with NAC now.
- D. Obtain two serum acetaminophen concentrations 1 hour apart to determine the drug’s elimination half-life to decide if treatment with NAC is indicated.
- E. Plot the acetaminophen concentration on the acetaminophen treatment nomogram to determine if treatment with NAC is indicated.

**Answer: C.** Many prescription and nonprescription analgesics contain acetaminophen, so although a patient may deny use of acetaminophen, suspicion should remain high. A patient with chronic acetaminophen ingestion should have an AST and acetaminophen concentration checked. If either is abnormal, treatment with NAC should be initiated. Many patients with repeated supratherapeutic ingestion will not have a markedly increased acetaminophen concentration, and the treatment nomogram is not used with repeated supratherapeutic dosing. Regardless of how long ago the ingestion occurred, if a patient displays signs or symptoms of liver damage, NAC should be given because it will still have beneficial effects.

**143.9.** A 55-year-old man is taking 10 grams of acetaminophen per day over the last 8 days for a toothache. He arrives to the emergency department with severe right upper quadrant (RUQ) pain, jaundice, and hypoglycemia. His aminotransferases, bilirubin, and acetaminophen concentration are highly elevated, and he is resuscitated and started on intravenous (IV) *N*-acetylcysteine (NAC). Which of the following laboratory findings is a very poor prognostic indicator and indicates that he is a candidate for immediate liver transplant?

- A. Aspartate transaminase (AST) >10,000 IU/L
- B. Bilirubin >5 mg/dL
- C. Lactate >5 mmol/L
- D. Acetaminophen concentration >150mg/dL
- E. pH <7.4

**Answer: C.** The patient has severe liver failure due to repeated supratherapeutic dosing of acetaminophen. Prognostic variables that are used to determine immediate hepatic transplant are the Kings College Criteria (a pH <7.3 [or lactate >3.5 mmol/L] after resuscitation *or* the combination of Cr >3.3 and PTT >100s [or INR >5] and grade 3 or 4 encephalopathy). Other criteria that

indicate high mortality are the APACHE II score >20. If a patient in the emergency department meets these criteria, immediate consultation with a hepatic transplant surgeon is indicated.

**143.10.** A 27-year-old woman is brought to the emergency department by emergency medical service (EMS). The patient is lethargic and cannot provide a history. A suicide note indicates that she ingested 50 g of acetaminophen approximately 24 hours ago. The patient is noted to be jaundiced with right upper quadrant (RUQ) tenderness. General supportive care is initiated. Her aspartate transaminase (AST) is 1072 IU. A serum acetaminophen concentration is pending. Which of the following statements is true regarding treatment with *N*-acetylcysteine (NAC)?

- A. Treatment with NAC should be delayed until the acetaminophen concentration is obtained.
- B. Treatment with NAC should be initiated because an ingestion of 50 g of acetaminophen is potentially fatal.

- C. Treatment with NAC should be initiated because the patient has liver injury secondary to acetaminophen poisoning.
- D. Treatment with NAC will not alter the outcome; this patient will require a liver transplant.
- E. Treatment with NAC will not be beneficial as the ingestion occurred more than 10 hours ago.

**Answer: C.** Ideally, NAC treatment is initiated within 8 hours of ingestion, but treatment with NAC is still beneficial even after hepatotoxicity has developed. An acetaminophen concentration should be obtained, but there is no reason to delay treatment. Ingestion of 50 g is potentially toxic, but decisions should be based on the patient's current condition. Occasionally, hepatotoxicity from acetaminophen is severe and liver transplant is required, but most cases of hepatotoxicity resolve with NAC treatment.

## KEY CONCEPTS

- Salicylates are profoundly toxic and can be fatal. Salicylate overdose requires active assessment and treatment. The other NSAIDs generally have self-limited toxicity and respond to supportive measures only. There is no antidote for any of these drugs.
- Salicylism should be considered in the differential diagnosis of altered mental status in the elderly.
- Acidemia signifies loss of respiratory compensation and acceleration of toxicity.
- The Done nomogram should not be used in the evaluation and treatment of salicylate toxicity.
- Salicylate concentrations and blood gas draws should occur every 2 hours until salicylate level is less than 30 mg/dL and is falling at least 10% between assays in the absence of measures to enhance elimination.
- Potassium stores are rapidly depleted in patients with salicylate intoxication and should be repleted with a goal serum level of 4.5 mEq/L.
- Mechanical ventilation should be avoided if possible in cases of severe salicylate poisoning. Acidosis may rapidly worsen due to loss of ventilation during the intubation procedure, and it is difficult to maintain ventilation at the level of physiological hyperventilation.
- If intubation is necessary, a bolus of sodium bicarbonate (50 to 100 mEq) is given before intubation and post-intubation minute ventilation is increased to match pre-intubation respiratory compensation.
- Enhanced elimination through urinary alkalization with a sodium bicarbonate drip should be initiated in acute toxicity with a level >30 mg/dL.
- Consultation with nephrology and preparation for hemodialysis should occur if the salicylate concentration is 80 mg/dL or is rising rapidly.
- Hemodialysis is recommended for signs of pulmonary or cerebral edema, coma, seizures, hepatic failure, renal failure, circulatory collapse, or refractory acidosis along with acute levels greater than 100 mg/dL and chronic levels of 40 mg/dL.
- Altered mental status in the setting of salicylate toxicity warrants IV glucose supplementation.
- Most NSAID overdoses are asymptomatic or cause only minor symptoms.
- Ibuprofen, along with other propionic acid derivatives, has been associated with sporadic cases of aseptic meningitis.
- The management of NSAID overdose is supportive, and there is no specific antidote. Hemodialysis is reserved for patients with massive overdose and pH <7.1.
- Patients who have ingested a pyrazolone or fenamate require observation for possible seizures until 8 hours after ingestion.

## CHAPTER 144: QUESTIONS &amp; ANSWERS

**144.1.** What type of acid-base disorder is caused by salicylate overdose?

- A. Metabolic acidosis and respiratory acidosis
- B. Metabolic acidosis and respiratory alkalosis
- C. Metabolic alkalosis and respiratory acidosis
- D. Metabolic alkalosis and respiratory alkalosis
- E. No acid-base disorder

**Answer: B.** Early in overdose, salicylates stimulate the respiratory center, causing hyperventilation and a respiratory alkalosis. Later, salicylates inhibit mitochondrial oxidative phosphorylation, resulting in anaerobic metabolism and a metabolic acidosis. This is the classic situation but is later followed by respiratory compensation, resulting in the possibility of a triple acid-base disorder.

**144.2.** A 22-year-old man presents 6 hours after a suicide-related aspirin overdose. His only complaint is of tinnitus, and his vital signs and physical examination are normal. His salicylate level is 47 mg/dL. His serum pH is 7.3, with an anion gap of 18 and a serum bicarbonate level of 17 mmol/L. Which of the following is the most appropriate therapy?

- A. Forced diuresis
- B. Hemodialysis
- C. Observation only
- D. Oral-activated charcoal due to chronic poisoning
- E. Urinary alkalization

**Answer: E.** Salicylates are acidic compounds and therefore readily ionize in an alkali environment. Only in the non-ionized state can they traverse cell membranes. Thus, once ionized in the urine, they are effectively “trapped” and can be easily excreted. Urinary alkalization is indicated in patients with a salicylate level greater than 30 mg/dL, significant acid-base disturbances, or increasing salicylate levels. Forced diuresis does not increase excretion, increases the risk for pulmonary and cerebral edema, and is never indicated. Hemodialysis is the ultimate treatment for salicylate poisoning but is generally reserved for patients with more severe signs or symptoms, more severe acid-base disturbances, or acute salicylate levels greater than 100 mg/dL. Observation alone would be indicated in a patient with a history of salicylate overdose but with no symptoms and normal laboratory values. AC can decrease the amount of salicylate absorbed if given within 1 hour of ingestion. Because large salicylate ingestions tend to form gastric concretions, multiple doses of AC may be indicated. AC is not used in chronic salicylate poisoning because the presentation occurs long after absorption.

**144.3.** Which of the following patients is at the highest risk of death?

- A. A 9-year-old boy with chronic salicylate ingestion and salicylate level of 10 mg/dL
- B. A 20-year-old pregnant woman with acute salicylate overdose and salicylate level of 100 mg/dL
- C. A 24-year-old man with acute salicylate overdose and salicylate level of 110 mg/dL
- D. A 30-year-old woman with chronic salicylate ingestion and salicylate level of 50 mg/dL
- E. A 42-year-old woman with acute salicylate overdose and salicylate level of 90 mg/dL

**Answer: D.** The mortality rate for chronic salicylate ingestion is 25 times that of acute salicylate ingestion. Infants and the elderly, as well as patients with comorbidities, are also at greater risk of death. Salicylate poisoning can cause severe fetal distress and ultimate fetal demise, but the prognosis for the mother is not significantly changed. In otherwise similar patients, a higher salicylate level is associated with a worse prognosis.

**144.4.** A 41-year-old man presents after an accidental ibuprofen overdose. He complains of epigastric pain, nausea, and one episode of vomiting. He reports that approximately 2 hours ago he took four 800-mg ibuprofen tablets. (He meant to take four 200-mg ibuprofen tablets.) Which of the following is the appropriate next step?

- A. Check electrocardiogram (ECG) to determine further treatment
- B. Check serum chemistry and salicylate level to determine further treatment
- C. Observation for resolution of symptoms
- D. Oral activated charcoal (AC)
- E. Urinary alkalization

**Answer: C.** Nonsteroidal antiinflammatory drugs (NSAIDs) are generally safe in overdose. Specifically, ibuprofen overdose often results in mild self-limited gastrointestinal (GI) upset. Typically, at least 100 mg/kg of ibuprofen needs to be ingested to cause symptoms. Rare, but serious, symptoms include coma, seizure, hypotension, hypothermia, GI bleeding, acute renal failure, and metabolic acidosis. All symptoms are treated with supportive care. Symptoms almost always develop within 4 hours of ingestion. In general, patients may be discharged in cases of small overdoses (<100 mg/kg), once symptoms resolve or after a 4-hour period of observation.

## KEY CONCEPTS

- Symptoms of muscarinic receptor blockade may include delirium, mydriasis, a lack of sweating, dry mucous membranes, ileus, urinary retention, hyperthermia, tachycardia, and hypertension.
- Delirium may be the sole manifestation of toxicity and only one-third of patients manifest all of the classic autonomic findings of tachycardia, dry skin and axilla, and mydriasis.
- Physostigmine should be given to control severe agitation and delirium precipitated by muscarinic receptor antagonism.
- Physostigmine is relatively contraindicated in patients with bradycardia or AV block in the setting of possible TCA toxicity.
- Benzodiazepines should be used for symptom control when seizures occur or when physostigmine is contraindicated.
- Patients who develop hyperthermia despite treatment with evaporative cooling should be paralyzed, intubated, and cooled.
- Symptomatic patients should be observed until symptoms are clearly resolving. Accidental ingestion with mild symptoms can be expected to improve in less than 6 hours. Purposeful ingestions with mild to moderate symptoms will require admission to the hospital for extended observation (24 to 48 hours).

## CHAPTER 145: QUESTIONS &amp; ANSWERS

- 145.1.** A 21-year-old man presents after drinking an “herbal tea” with some friends. He reports visual hallucinations. He has a resting tachycardia and a mildly elevated temperature. On physical examination, he is noted to have dry mucous membranes, dry and flushed skin, and absent bowel sounds. In addition to certain plants, which of the following medications can also cause these symptoms?
- A. Amiodarone
  - B. Clonidine
  - C. Diphenhydramine
  - D. Lidocaine
  - E. Morphine

**Answer: C.** This patient is experiencing the antimuscarinic toxidrome. In addition to the signs and symptoms described here, patients may also have mydriasis and bladder distention. Mental status can be agitated or depressed. Myoclonus or choreoathetoid movements can also be seen. Amiodarone can cause hypothyroidism or hyperthyroidism and skin discoloration, as well as several other long-term effects. Clonidine can cause dry mouth, drowsiness, bradycardia, and hypotension. Lidocaine can cause headaches, dizziness, confusion, tinnitus, and tremor, as well as bradycardia and hypotension. Morphine can cause respiratory cerebral depression, as well as miosis, bradycardia, and hypotension.

- 145.2.** Many signs and symptoms of the antimuscarinic syndrome are similar to those of other syndromes, including the sympathomimetic syndrome, serotonin syndrome, and neuroleptic malignant syndrome. Which of the following antimuscarinic findings is most likely to distinguish the antimuscarinic syndrome from the other syndromes listed?
- A. Altered mental status
  - B. Altered movements
  - C. Dry skin
  - D. Fever
  - E. Mydriasis

**Answer: C.** All the other syndromes often have some degree of diaphoresis. Fever, altered mental status, and mydriasis can occur in all the named syndromes. Myoclonus can occur in the antimuscarinic syndrome, tremor in the serotonin syndrome, and rigidity in the neuroleptic malignant syndrome.

- 145.3.** A 31-year-old woman presents with altered mental status after ingesting an unknown quantity of an unknown medication. Her vital signs are significant for tachycardia and fever. Her physical examination reveals mydriasis, dry mucous membranes, dry skin, decreased bowel sounds, and hypotension. Her electrocardiogram (ECG) reveals a wide QRS complex and prolonged QT interval. Which of the following medications is associated with this toxidrome?
- A. Amitriptyline
  - B. Dextroamphetamine

- C. Diphenhydramine
- D. Fluoxetine
- E. Lithium

**Answer: A.** This patient is experiencing many of the signs and symptoms of antimuscarinic syndrome. However, pure antimuscarinic rarely if ever cause cardiac dysrhythmias (other than sinus tachycardia). Tricyclic antidepressants (TCAs) frequently cause antimuscarinic signs and symptoms but also cause dysrhythmias. Although selective serotonin reuptake inhibitors, stimulants, and lithium can all cause similar signs and symptoms, electrocardiographic abnormalities such as those described here are rare.

- 145.4.** Which diagnostic test should be performed in almost all patients presenting with the antimuscarinic syndrome?
- A. Arterial blood gas analysis
  - B. Computed tomography (CT) scan of the brain
  - C. Electrocardiography
  - D. Electroencephalography
  - E. Urine drug screen

**Answer: C.** Patients with a clear presentation and mild symptoms do not necessarily require any diagnostic evaluation. However, patients with more severe symptoms should have measurements of serum electrolytes, renal function, creatine kinase, and glucose concentration performed. Electrocardiography is most helpful because cyclic antidepressants are a common cause of antimuscarinic symptoms and can cause fatal cardiac dysrhythmias. Arterial blood gas analysis might be helpful if the patient has respiratory depression. Head CT might be indicated in patients with altered mental status of unknown cause. Electroencephalography would be indicated only if there is a suspicion of unrecognized seizures. Urine drug screens are almost never helpful in determining treatment, especially in the case of antimuscarinic syndrome because they will not detect most of the medications responsible for this syndrome.

- 145.5.** What is the best initial treatment of hyperthermia in patients with antimuscarinic syndrome?
- A. Acetaminophen
  - B. Cooling blankets
  - C. Dantrolene
  - D. Evaporative cooling
  - E. Physical restraints

**Answer: D.** Evaporative cooling is the most effective and noninvasive way to decrease temperature. Death has occurred because of untreated hyperthermia in patients with antimuscarinic syndrome. Antipyretics such as acetaminophen are ineffective at reducing temperature because hyperthermia is not “fever.” Dantrolene is useful in malignant hyperthermia but has no role in hyperthermia of other causes. Cooling blankets are ineffective. Physical restraints are likely to worsen the problem and to increase the risk of rhabdomyolysis and myoglobinuric renal failure. If a patient is dangerously agitated, physostigmine are the agents of choice to decrease agitation, muscle activity, and related metabolic activity that contribute to hyperthermia.

**145.6.** Which of the following medications crosses the blood-brain barrier and is potentially useful in the treatment of antimuscarinic syndrome?

- A. Edrophonium
- B. Metoclopramide
- C. Neostigmine
- D. Physostigmine
- E. Pyridostigmine

**Answer: D.** Metoclopramide is an antiemetic and prokinetic medication that has no role in antimuscarinic syndrome. All of the other agents are acetylcholinesterase inhibitors, but only physostigmine crosses the blood-brain barrier and so it is the only drug that can reverse the central and peripheral effects of antimuscarinic medications. However, physostigmine can cause serious side effects and thus should be used carefully in patients with bradycardia and A-V block.

**145.7.** Which of the following is a contraindication to physostigmine use in a patient with antimuscarinic syndrome?

- A. Altered mental status
- B. Bradycardia and atrioventricular (AV) blockade

- C. Coexisting myasthenia gravis
- D. Hyperthermia
- E. Seizure

**Answer: B.** Physostigmine is an acetylcholinesterase inhibitor that is useful to reverse the effects of antimuscarinic medications. However, it is contradicted with narrow angle glaucoma, AV blockade, bradycardia, and seizures due to the causal overdose. The main benefit of physostigmine is to reverse the altered mental status and agitation caused by the antimuscarinic medication. Physostigmine is occasionally used to treat myasthenia gravis. Hyperthermia and seizures can occur as part of the antimuscarinic syndrome, and although neither is directly treated with physostigmine, they are not contraindications to its use.



## KEY CONCEPTS

- Although rarely used for depression, MAOIs are used in the treatment of Parkinson's disease.
- Because serious symptoms can occur after a lengthy latent period, patients with reported MAOI overdose should be admitted for 24 hours, regardless of symptoms. Symptoms are characterized by tachycardia, hypertension, and CNS changes, and later cardiovascular collapse.
- The primary manifestations of TCA toxicity are seizures, tachycardia, and intraventricular conduction delay. IV sodium bicarbonate should be administered for QRS prolongation.
- SSRIs are relatively benign in overdose.
- SNRI ingestions can result in seizures, tachycardia, and occasionally intraventricular conduction delay.
- The hallmark feature of serotonin syndrome is lower extremity rigidity with spontaneous or inducible clonus, especially at the ankles.
- Serotonin syndrome is primarily treated with supportive care, including discontinuation of the offending agent, and benzodiazepines.

## CHAPTER 146: QUESTIONS &amp; ANSWERS

- 146.1.** A 42-year-old woman presents after ingesting an unknown number of pills in a suicide attempt. She does not know the name of the medication she ingested but knows it is an antidepressant. She denies taking any co-ingestants. Currently, she has no complaints; her vital signs, physical examination findings, and electrocardiogram (ECG) are normal. To receive a psychiatric evaluation, she must be transferred off-site. How long should she be observed in the emergency department before transfer to a psychiatric facility?
- 1 hour
  - 2 hours
  - 6 hours
  - 12 hours

**Answer: C.** The most dangerous class of antidepressants is the cyclic antidepressants. Typically, peak plasma concentrations and therefore peak effect occur in 2 to 4 hours. However, in overdose, the anticholinergic effects of these agents may result in delayed gastric emptying and delay peak absorption to 6 hours. Most serious signs and symptoms occur within 30 to 60 minutes of ingestion. If the patient has tachycardia or seizure or decreased level of consciousness at 6 hours, she should be admitted for medical observation. If any of these pills were a monoamine oxidase inhibitor (MAOI), however, the patient should be admitted to the hospital for 24 hours.

- 146.2.** After sinus tachycardia, what is the most common electrocardiographic abnormality seen in cyclic antidepressant overdose?
- Left bundle branch block
  - PR prolongation
  - QRS prolongation
  - QT prolongation
  - Right bundle branch block

**Answer: C.** After sinus tachycardia, QRS prolongation of more than 100 milliseconds is the most common specific finding and results from sodium channel-blocking effects of the cyclic antidepressant. Prolonged PR and QT intervals, as well as a right bundle branch block, can also occur but are less common.

- 146.3.** Which of the following treatment options would be the most appropriate to consider in the awake, asymptomatic patient who presents within 1 hour of a large overdose of a tricyclic antidepressant (TCA)?
- Activated charcoal
  - Endotracheal intubation
  - Gastric lavage
  - Physostigmine
  - Sodium bicarbonate

**Answer: A.** Physostigmine should never be prophylactically administered and its use in TCA overdose is generally considered contraindicated, particularly in patients with bradycardia, A-V block, and seizures related to the overdose. Sodium bicarbonate should not be prophylactically administered either, but it should be administered as an intravenous (IV) bolus for patients with intraventricular conduction delay and QRS widening. Endotracheal intubation is indicated for patients with significant central nervous system (CNS) depression who are not able to protect their airway. Gastric lavage is not routinely indicated. Activated charcoal can be considered in an awake individual. It should not be "forced" on someone who will not voluntarily drink it (eg, by placement of a nasogastric tube for the purpose of administering charcoal) because of the increased risk of aspiration and subsequent charcoal pneumonitis.

- 146.4.** A 23-year-old man presents after an ingestion of a cyclic antidepressant. His initial vital signs are normal. During your initial evaluation, the patient begins to seize. Which agent should be administered first?
- Lorazepam
  - Phenobarbital
  - Phenytoin
  - Propofol
  - Valproic acid

**Answer: A.** Lorazepam or any other benzodiazepine is the first-line treatment of toxin-induced seizures. Intravenous phenytoin can increase the incidence of ventricular tachycardia and is not generally effective in controlling toxin-induced seizures. Phenobarbital and propofol are effective but take longer to give and typically are used after benzodiazepines. Valproic acid is not likely to be effective.

- 146.5.** A 57-year-old woman presents with altered mental status. A friend states that the patient takes antidepressant medications and has recently been complaining of symptoms of an upper respiratory tract infection. The patient is noted to have a temperature of 39.2° C and a pulse of 135 beats/minute. Otherwise, her vital signs are within normal limits. On examination, she has a tremor, myoclonus, and diaphoresis. Which of the following is the most consistent with this presentation?
- Anticholinergic syndrome
  - Cocaine intoxication
  - Cyclic antidepressant overdose
  - Neuroleptic malignant syndrome (NMS)
  - Serotonin syndrome

**Answer: E.** Symptoms of serotonin syndrome include altered mental status, agitation, ataxia, diaphoresis, diarrhea, hyperreflexia, hyperthermia, myoclonus, shivering, and tremor. Many of the symptoms are similar to symptoms caused by NMS and sympathomimetic overdoses; however, myoclonus is unique to the serotonin syndrome. Additional historical features consistent with the serotonin syndrome are the fact that the patient is taking an antidepressant, possibly a selective serotonin reuptake inhibitor (SSRI), and has likely added an over-the-counter "cold" medication. Many of these medications contain dextromethorphan, which also decreases serotonin reuptake and can precipitate the serotonin syndrome in patients taking SSRIs.

- 146.6.** A 24-year-old man presents after taking an overdose of his antidepressant. He does not know the name of the drug. He has no complaints, and his vital signs and physical examination findings are normal. Soon after completing your evaluation, the patient experiences a tonic-clonic seizure. Which of the following antidepressants is most likely to produce seizures without other symptoms of severe toxicity?
- A. Amitriptyline
  - B. Bupropion
  - C. Fluoxetine
  - D. Phenelzine
  - E. Trazodone

**Answer: B.** Bupropion can induce seizures even at therapeutic levels. Other adverse effects include tachycardia, tremulousness, hallucinations, and QRS prolongation. Cyclic antidepressants (amitriptyline), selective serotonin reuptake inhibitors (SSRIs; fluoxetine), and monoamine oxidase inhibitors (MAOIs; phenelzine) can also cause seizures but less frequently than bupropion and usually with other symptoms of serious intoxication such as central nervous system (CNS) depression or QRS prolongation.

- 146.7.** A patient is prescribed a new medication that he takes each night. After 4 days, he is drowsy and noted to have orthostatic hypotension, nausea, vomiting, and priapism. What medication is most likely involved?
- A. Amitriptyline
  - B. Bupropion
  - C. Fluoxetine
  - D. Phenelzine
  - E. Trazodone

**Answer: E.** Trazodone and nefazodone may cause orthostatic hypotension and lethargy. Priapism is a relatively unique complication of trazodone and is more common with therapeutic use rather than in acute overdose.

- 146.8.** A patient presents after a substantial accidental overdose of her monoamine oxidase inhibitor (MAOI), which she confused with her megavitamin therapy. There is no need for psychiatric evaluation. She is asymptomatic and has normal vital signs and a normal physical examination. What is the appropriate disposition?
- A. Admit to intensive care unit for a minimum of 24 hours of observation
  - B. Admit to ward for a minimum of 24 hours of observation
  - C. Discharge home
  - D. Observe for 6 hours, then discharge home
  - E. Observe for 12 hours, then discharge home

**Answer: A.** All patients who overdose on MAOIs should be admitted for at least 24 hours of observation because symptom onset is often delayed. In addition, the effects of overdose may be severe and require aggressive therapy.

## KEY CONCEPTS

**Cardioactive Steroids**

- Digoxin toxicity is often occult and should be considered in any patient who is on digoxin and presents with gastrointestinal or visual disturbance and a new dysrhythmia or conduction disturbance.
- Digitalis Fab is the specific antidote for digoxin toxicity and is dosed by body load of digitalis, not by body weight of the patient.
- Indications for digitalis Fab are summarized in Box 147.4, and Fab should be used before pacing or antidysrhythmic drugs.
- Hyperkalemia in acute digitalis toxicity is best treated with Fab fragments. Conventional treatment as for any other cause of hyperkalemia is also appropriate when Fab fragment preparations are not immediately available.

**Beta-Adrenergic Blockers**

- Beta-blocker intoxication usually causes bradycardias and occasionally AV block.
- Noncardiac symptoms such as obtundation, seizures, and hypoglycemia may occur, especially early in the course and particularly with propranolol.
- Volume expansion, atropine, calcium, and glucagon are early treatment measures, but absent a response, begin a HDI/glucose infusion.

- When using HDI/glucose infusions, concentrate glucose solutions to avoid fluid overload.

**Calcium Channel Blockers**

- Signs and symptoms of calcium channel blocker intoxication often occur early after overdose but may be significantly delayed with sustained release products.
- AV block and bradycardias predominate with verapamil and diltiazem; dihydropyridine calcium channel blockers often present with tachycardia.

**Clonidine**

- Clonidine poisoning may mimic opioid poisoning and is best treated with crystalloid fluids followed by an infusion of norepinephrine.

**Nitrates, Nitrites, and Methemoglobinemia**

- Nitrates are contraindicated in patients who have recently taken phosphodiesterase inhibitors for erectile dysfunction.
- Patients with a methemoglobin concentration of 25% and symptoms of anemia should be treated with methylene blue.

## CHAPTER 147: QUESTIONS &amp; ANSWERS

**147.1.** A 72-year-old man presents with a chief complaint of nausea. He also complains of blurred vision and general weakness. His vital signs and physical examination are normal. He has a past medical history significant for myocardial infarction, congestive heart failure, hypertension, and diabetes. He states that he takes all prescribed medications regularly and just took all of his medications as prescribed approximately 1 hour ago. Reviewing his medication list, you note that one of his medications is digoxin. Which of the following should be done?

- Administer oral potassium.
- Give digoxin-specific Fab fragment antibodies now.
- Give digoxin-specific Fab fragment antibodies only if he has an abnormal electrocardiogram (ECG).
- Obtain a serum digoxin level in 6 hours.
- Obtain a serum digoxin level now.

**Answer: D.** The steady-state (as opposed to peak) digoxin level is most closely correlated with toxicity. Peak level is reached in 1.5 to 2 hours, whereas steady-state levels are not reached until 6 to 8 hours after ingestion. As long as a patient is stable and a chronic ingestion is suspected, digoxin levels taken soon after ingestion are not helpful. Other diagnostic studies should be undertaken while waiting for the digoxin level, including, but not limited to, an electrocardiogram (ECG) and serum electrolyte determination.

**147.2.** In a patient with a known digoxin overdose, which of the following is an indication for administration of digitalis antibody fragments?

- Acute ingestion of 10 mg of digoxin
- Atrial fibrillation with rapid ventricular response
- First-degree heart block
- Ingestion of oleander (*Nerium oleander*)
- Serum potassium greater than 5 mEq/L

**Answer: E.** Hyperkalemia is an indication for treatment with digitalis antibody fragments. Other indications include severe ventricular dysrhythmias; hemodynamically significant bradycardias unresponsive to atropine; rapidly progressive rhythm disturbances or rising potassium level; co-ingestion of cardiotoxic drugs such as beta-blockers, calcium channel blockers, or cyclic antidepressants; or ingestion of a plant known to contain cardiac glycosides in the setting of severe dysrhythmias.

**147.3.** A 27-year-old man presents after ingesting 8 mg of digoxin in a suicide attempt. He has ventricular tachycardia on his electrocardiogram (ECG). His blood pressure is 93/54 mm Hg. Laboratory results are not available. You decide to treat with digitalis antibody fragments. How many vials should be given to bind the entire ingestion?

- 2 vials
- 4 vials
- 8 vials
- 16 vials
- 20 vials

**Answer: D.** Each vial contains enough digitalis antibody fragments to neutralize 0.5 mg of digoxin; therefore the patient should be given 16 vials of Fab fragments to fully treat his ingested dose.

**147.4.** A 5-year-old girl presents after taking some of her grandmother's heart medications. She has sinus bradycardia and a slightly low blood pressure. The remainder of her vital signs and physical examination are nonspecific. A bedside glucose test reveals hyperglycemia. The child is not responsive to calcium therapy. The next therapeutic intervention that is likely to treat both the endocrine and cardiovascular pathology would be:

- A. Dobutamine
- B. Epinephrine
- C. High-dose insulin (HDI)
- E. Intravenous fat emulsion (IFE)
- E. Glucagon

**Answer: C.** Calcium channel blocker toxicity may result in bradycardia and hypotension, much like beta-blocker toxicity. Unlike beta-blocker toxicity, which can cause hypoglycemia, calcium channel blockers can cause hyperglycemia via blockade of calcium channels on beta islet cells. HDI therapy treats calcium channel blocker toxicity via increasing inotropy, as well as normalizing glucose.

- 147.5. A 60-year-old man has taken an overdose of his beta-blocker medication. He is awake and alert but has a pulse of 50 beats per minute and a blood pressure of 92/60 mm Hg. Which of the following is the most appropriate initial treatment?
- A. Atropine, crystalloid fluids, calcium salts, glucagon
  - B. Atropine, crystalloid fluids, insulin
  - C. Atropine, dopamine, glucagon
  - D. Dopamine, crystalloid fluids, insulin
  - E. Dopamine, glucagon, insulin

**Answer: A.** Atropine, crystalloid fluids, calcium salts and glucagon are the initial treatments of choice for beta-blocker toxicity. If these agents are ineffective, high-dose insulin (HDI) is reasonable as next-line therapy for cardiogenic shock. If HDI is ineffective, catecholamines are a reasonable option. The catecholamine choice may vary depending on the type of shock the patient is in, and the dose needed for a response may be greater than for other conditions.

- 147.6. A patient presents after an apparent overdose of diltiazem. Which of the following findings would lead you to suspect a co-ingestant in addition to the calcium channel blocker?
- A. Atrioventricular (AV) block on electrocardiogram (ECG)
  - B. Hyperglycemia
  - C. Metabolic acidosis
  - D. Prolonged QRS complex on ECG
  - E. Respiratory depression

**Answer: D.** Prolonged QRS and QT intervals are generally not seen in calcium channel blocker overdose and should prompt the search for co-ingestants. One exception is the calcium channel blocker bepridil, which can cause QRS or QT prolongation. All the other listed abnormalities are typical of calcium channel blocker overdose.

- 147.7. Treatment for an overdose of beta-blockers is most similar to the treatment for an overdose of which other class of medication?
- A. Anticholinergics
  - B. Calcium channel blockers
  - C. Cyclic antidepressants
  - D. Digoxin
  - E. Nitrates

**Answer: B.** Symptoms from overdose of calcium channel blockers and beta-blockers are similar, as are the therapeutic strategies. Severe anticholinergic toxicity may respond to physostigmine administration, cyclic antidepressants to intravenous (IV) sodium bicarbonate boluses, digoxin poisoning to antibody Fab fragments, and nitrate toxicity to methylene blue therapy.

- 147.8. Which of the following drugs can kill a toddler with ingestion of a single tablet?
- A. Atenolol
  - B. Chlorthalidone
  - C. Lisinopril
  - D. Nitroglycerin
  - E. Verapamil

**Answer: E.** Verapamil and other calcium channel blockers can kill a toddler with the ingestion of a single tablet. Appropriate medical treatment, however, is extremely effective, and very few children die from calcium channel blocker overdose. Although beta-blockers have the potential to cause serious toxicity, propranolol is the beta-blocker most likely to cause serious toxicity. Educating parents and caregivers of young children about the potential effects of these medications is important.

## KEY CONCEPTS

- Health care workers caring for patients with caustic exposures should adhere to universal precautions to prevent additional exposure.
- All symptomatic patients should undergo endoscopy and be considered for admission.
- Asymptomatic patients can undergo endoscopy in the emergency department or be discharged with close follow-up monitoring.
- Gastric emptying or GI decontamination is not indicated for the majority of caustic ingestions.
- Concentration and pH are the most important characteristics of a substance to predict esophageal and gastric injury.
- Button batteries lodged in the airway or esophagus require endoscopic retrieval.

## CHAPTER 148: QUESTIONS &amp; ANSWERS

**148.1.** A patient presents after the intentional ingestion of hydrochloric acid (HCl). He complains of mouth, throat, and chest pain, as well as painful swallowing and nausea. His vital signs are normal. Physical examination reveals oral burns without edema. The remainder of the examination is normal. You decide that in addition to psychiatric consultation, the patient should have upper endoscopy. What is the best time for the patient to have the endoscopy?

- A. Immediately
- B. In 2 to 4 hours
- C. In 4 to 12 hours
- D. In 12 to 24 hours
- E. In 2 or 3 days

**Answer: D.** The ideal time for endoscopy is 12 to 24 hours. Endoscopy done too soon may miss the extent or depth of injury, whereas endoscopy after 24 hours is actually more likely to cause perforation because the wounds have softened. All patients with signs or symptoms of strong acid ingestion as well as patients with intentional ingestion should have endoscopy performed.

**148.2.** A patient presents immediately after the ingestion of bleach. The patient is awake and alert and complaining only of mouth pain. His vital signs and physical examination findings are normal. You consider having the patient drink fluids to dilute the bleach. Which of the following statements regarding this therapy is *true*?

- A. Dilution is beneficial only if it is done very soon after ingestion.
- B. In cases of alkali ingestions, dilution with a mild acid such as acetic acid is best.
- C. Large volumes of fluid should be used.
- D. Milk should always be used instead of water.
- E. Patients should also be encouraged to eat solids.

**Answer: A.** Dilution, if it is done at all, should be done early because injuries from caustics occur almost immediately. Water and milk are equally beneficial and are the agents of choice. Weak acids or alkalis should never be used for dilution, because they can cause thermal reactions that worsen the injury. Small volumes up to approximately 500 mL should be used. Solids are not beneficial and can complicate the situation and increase the risk of aspiration.

**148.3.** A patient presents after an intentional caustic ingestion. She complains of hoarseness, with mouth, throat, and chest pain. Burns are present on her lips and oral mucosa and she is drooling. Her vital signs are normal, as is the remainder of her physical examination. Which of the following is the most appropriate treatment?

- A. Administer 500 mL water orally
- B. Administer intravenous Solu-Medrol

- C. Endotracheal intubation
- D. Obtain electrocardiogram
- E. Upper endoscopy

**Answer: C.** Early intubation is indicated if there is any evidence of airway compromise, such as hoarseness, throat pain, drooling, or edema. Because edema and secretions can both increase rapidly and can make intubation difficult or even impossible, preparations should be made for a difficult airway. Fluids for oral dilution should not be given if the patient has difficulty swallowing. Corticosteroids have been studied to decrease the incidence of stricture formation, but evidence for their benefit is lacking and serious side effects can occur. With the exception of hydrofluoric acid, an electrocardiogram is not routinely needed for caustic ingestions, and endoscopy should be performed 12 to 24 hours after the ingestion and after the airway has been secured.

**148.4.** What empirical treatment is indicated to prevent systemic toxicity from hydrofluoric acid ingestions?

- A. Calcium chloride
- B. Magnesium chloride
- C. Potassium chloride
- D. Sodium bicarbonate
- E. Sodium chloride

**Answer: A.** Calcium chloride is indicated in significant hydrofluoric acid exposures. Although hydrofluoric acid is a weak acid, the fluoride ion is extremely electronegative and will bind with multiple cations, specifically calcium and magnesium. Profound hypocalcemia is responsible for most deaths from hydrofluoric acid exposure and can occur before a serum calcium concentration can be measured.

**148.5.** A 3-year-old boy presents after swallowing a button battery. What is the most appropriate management?

- A. Endoscopic removal
- B. Inpatient observation
- C. Radiograph to assess anatomic location
- D. Surgical removal
- E. Whole-bowel irrigation

**Answer: C.** Outpatient observation is warranted for button batteries that are located in the stomach or intestines, which can be assessed by plain radiographs. Batteries lodged in the esophagus require endoscopic removal. Examination of the stool for passage of the battery is recommended. If it is not passed in 1 week, repeated radiographs should be obtained. Inpatient observation is not needed as long as close follow-up can be ensured. Surgical removal and whole-bowel irrigation are not beneficial and are potentially deleterious.



## KEY CONCEPTS

- Rapid sedation with an IV benzodiazepine is the key for most symptoms from cocaine and other stimulants.
- Hyperthermia is a high-risk event, and body temperature must be reduced rapidly.
- Short-acting antihypertensive agents (such as, phentolamine, nitroglycerin, nicardipine, or clevidipine) are recommended for cocaine-induced hypertension, including in the presence of chest pain.
- Wide-complex rhythms secondary to cocaine may respond to IV sodium bicarbonate therapy.
- Cocaine body packers who develop symptoms of acute cocaine toxicity need emergent surgical intervention.
- Amphetamine symptoms and effects last longer than those produced by cocaine.
- Hyponatremia should be rapidly identified in patients with an altered mental status after use of illicit stimulants, most specifically MDMA.
- Synthetic cathinones or “bath salts” may be ingested, inhaled, or injected and can result in severe agitation, sympathomimetic effects, hyperthermia, and rhabdomyolysis. Fatalities have been reported.

## CHAPTER 149: QUESTIONS &amp; ANSWERS

**149.1.** How long does a typical urine drug screen result remain positive after use of cocaine?

- A. 1 day
- B. 3 days
- C. 1 week
- D. 2 weeks
- E. 1 month

**Answer: B.** Urine drug screens detect the cocaine metabolite benzoylecgonine, which is typically present in the urine for 3 days after the last use.

**149.2.** A 24-year-old man is seen by police to be smoking crack cocaine on a street corner. On the way to jail, the patient reports a severe headache, so the police bring him to the emergency department (ED) for medical clearance. The patient is awake with normal mental status but continues to complain of diffuse head pain. His vital signs are blood pressure (BP), 195/99 mm Hg; heart rate (HR), 102 bpm; respiratory rate (RR), 18 rpm; and temperature, 37.2°C. His physical examination is normal. How should his headache be evaluated?

- A. Acetaminophen administration, discharge if headache resolves
- B. Blood pressure reduction, discharge if headache resolves
- C. Head computed tomography (CT) scan, discharge if normal
- D. Head CT scan, lumbar puncture if normal, discharge if both are normal
- E. No evaluation needed; cocaine is not associated with headache

**Answer: D.** Cocaine is associated with subarachnoid hemorrhage (SAH). Patients complaining of a severe headache after cocaine use should receive a complete evaluation for SAH, including head CT and lumbar puncture. In addition, elevated blood pressure should be lowered while the evaluation is being performed.

**149.3.** What is the preferred primary method for controlling a combative patient suffering from a sympathomimetic overdose?

- A. Chlorpromazine
- B. Diazepam
- C. Droperidol
- D. Haloperidol
- E. Physical restraints

**Answer: B.** Diazepam and other benzodiazepines are the best agents to sedate and establish control of an agitated patient. They cause sedation as well as decrease muscle tone, which can ameliorate hyperthermia. In addition, they can lower the acutely

increased blood pressure often seen with sympathomimetic use. In the agitated patient when intravenous (IV) access may be difficult to establish, lorazepam is more predictably absorbed than diazepam. Chlorpromazine can be given intramuscularly to provide rapid sedation, but is associated with anticholinergic effects that may exacerbate hyperthermia. Butyrophenone agents (eg, haloperidol and droperidol) are reserved for more severe agitation and are considered secondary methods of treatment after adequate doses of benzodiazepines. Also, they may have associated dysrhythmic effects that are additive to those of cocaine. Physical restraints may be necessary initially but are not desirable, because they can also increase the risk of hyperthermia as well as increase agitation, which is associated with sudden death.

**149.4.** A 27-year-old woman presents with severe chest pain that began soon after use of a large amount of cocaine. She describes the pain as “tearing from my chest to my back.” Her vital signs are blood pressure (BP), 210/112 mm Hg; heart rate (HR), 142 bpm; respiratory rate (RR) 22 rpm; and temperature, 38.0°C. A BP measurement taken in the other arm is 147/86 mm Hg. An electrocardiogram (ECG) is normal. You are highly suspicious that the patient is suffering from an aortic dissection and order a transesophageal ultrasound examination while contacting the cardiothoracic surgeon. In the meantime, what should you use to lower her blood pressure?

- A. Labetalol
- B. Nitroglycerine
- C. Nitroprusside
- D. Phentolamine
- E. Treatment should be withheld until a definitive diagnosis is made.

**Answer: D.** Phentolamine is a direct alpha-adrenergic antagonist and is the drug of choice for sympathomimetic-induced hypertension with end-organ damage. Labetalol and beta-blockers are not recommended, because they have little to no clinical benefit in this setting. Nitroprusside and nitroglycerine are acceptable agents if phentolamine is not available. Treatment should not be withheld, because rapid blood pressure control could be lifesaving.

**149.5.** A 35-year-old man presents with chest pain that started approximately 2 hours ago, soon after he smoked crack cocaine. The pain occurred with exertion and has not resolved. He has no previous medical history. His vital signs are blood pressure (BP), 182/99 mm Hg; heart rate (HR), 122 bpm; respiratory rate (RR) 18 rpm; and temperature, 38.2°C. His electrocardiogram (ECG) shows sinus tachycardia with ST depression in the anterior leads. The chest radiograph is normal. Laboratory results are significant for elevations in creatine kinase (CK), CK-MB, and troponin I. What is the likely explanation for his elevated serum cardiac markers?

- A. He has a completely occluded coronary artery causing ischemia.
- B. He has coronary artery spasm without ischemia.
- C. He has coronary stenosis causing ischemia.
- D. He has fever and rhabdomyolysis but no cardiac disease.
- E. His elevated blood pressure is causing cardiac strain but not ischemia.

**Answer: C.** Although cocaine can cause coronary spasm with resultant chest pain, patients with positive serum markers are likely to have significant angiographic stenosis. Cocaine users who have complete coronary occlusion typically develop ST elevation just as non-cocaine users do. His elevated blood pressure and fever are certainly increasing the workload on the heart but are not causing his elevated cardiac markers. Cocaine patients may suffer from rhabdomyolysis, and although the resultant renal failure can slow the clearance of the cardiac markers, it does not cause the elevation.

**149.6.** A 24-year-old man is brought to the emergency department (ED) in police custody after he admitted to swallowing multiple packets of cocaine to smuggle them through an airport. The patient has no complaints. His physical examination is normal. An abdominal radiograph shows multiple slightly radiopaque areas consistent with packets of cocaine. An electrocardiogram (ECG) is normal. What is the most appropriate management of this patient?

- A. Endoscopic removal of packets
- B. No therapy needed; the patient may be discharged
- C. Observation alone to watch for elimination of packets
- D. Surgical removal of packets
- E. Whole bowel irrigation to remove packets

**Answer: E.** Whole bowel irrigation with polyethylene glycol facilitates passage of the packets and is safe and effective. Endoscopic removal should be avoided, because there is increased risk of packet rupture. Emergent surgical removal is indicated if there is evidence of packet leak and the patient becomes symptomatic. The patient needs to be observed with cardiac monitoring at a center capable of emergent surgery until all packets have passed.

**149.7.** Which unique life-threatening electrolyte abnormality is seen with the use of *N*-methyl-3,4-methylenedioxymphetamine (MDMA)?

- A. Hyperkalemia
- B. Hyponatremia
- C. Hypokalemia
- D. Hypomagnesemia
- E. Hyponatremia

**Answer: E.** Hyponatremia can occur with MDMA use and can be severe and life-threatening. MDMA alters the release of vasopressin and will induce a clinical syndrome resembling the syndrome of inappropriate secretion of antidiuretic hormone (SIADH). The patients have concentrated urine with high urine sodium content. Seizures can occur and should be treated with hypertonic saline. In the absence of seizures or other life-threatening conditions, general supportive care with water restriction is adequate treatment.

## KEY CONCEPTS

- Hallucinogens include many types of drugs and chemicals with different associated effects, including action at serotonin receptors, dopamine receptors, and NMDA receptors.
- Diagnosis and management are based primarily on the history and physical examination, with hallmarks of therapy including supportive care, a calm quiet environment, and sedation with benzodiazepines such as diazepam or lorazepam. Severely agitated patients may benefit from butyrophenone antipsychotic agents such as haloperidol and droperidol.
- Screening tests for drugs of abuse are of limited value in the acute management of intoxicated patients.
- Novel synthetic hallucinogens continue to emerge and may have effects from hallucinogenic, serotonergic, and dissociative toxidromes. These drugs are rarely detected by screening tests, and cases of toxicity may occur in regional outbreaks.
- Patients with PCP toxicity can have unpredictable, violent behavior, and may sustain traumatic injuries. Extreme agitation, although possible, is less common with ketamine and methoxetamine.
- Extremely agitated, violent PCP-intoxicated patients may require rapid sedation to decrease danger to the patient and providers. For hyperthermic patients, sufficient sedation to decrease neuromuscular hyperactivity may require intubation, paralytics, and active external cooling to decrease the risk of multiorgan failure and mortality.
- The care of patients intoxicated from marijuana and synthetic cannabinoids consists of prevention of injury and reassurance for those who have panic reactions. An extremely agitated patient can be sedated with oral or parenteral administration of benzodiazepines or antipsychotics. High doses of antiemetics may be necessary to treat the nausea and vomiting associated with synthetic cannabinoids and heavy daily marijuana use—cannabinoid hyperemesis syndrome.
- The central nervous system and physiologic effects of mescaline use are similar to those of lysergic acid diethylamide (LSD) derivatives, but more vivid hallucinations can occur. Nausea and vomiting are pronounced and almost always precede the hallucinogenic effects.

## CHAPTER 150: QUESTIONS &amp; ANSWERS

**150.1.** Intoxication with morning glory seeds will mimic intoxication with which of the following hallucinogens?

- A. Ecstasy
- B. Ketamine
- C. LSD
- D. Marijuana
- E. PCP

**Answer: C.** Several plants contain alkaloids similar to LSD, including morning glory and Hawaiian baby wood rose.

**150.2.** A 14-year-old boy presents with altered mental status. On examination he has mydriasis, nystagmus, and lethargy. There is a history of exposure to skittles. His urine drug screen for drugs of abuse is presumptively positive for PCP. Which toxicant did he ingest?

- A. Dextromethorphan
- B. Ecstasy
- C. Ketamine
- D. Psilocybin
- E. Synthetic cannabinoids

**Answer: A.** Dextromethorphan presents with more of a dissociative clinical pattern than opioids. Skittles, red hots, and triple C are street names for over-the-counter tablets of dextromethorphan. Most immunoassays for PCP cross-react with dextromethorphan to give a false-positive PCP report. Ketamine can also give a similar clinical picture, so the history is also necessary to determine which is the most likely intoxicant in the differential.

**150.3.** Which of the following urine immunoassays is most likely to give a true-positive result for its class of compounds?

- A. Amphetamines
- B. Benzodiazepines

- C. Benzoyllecgonine (cocaine metabolite)
- D. Phencyclidine
- E. Tetrahydrocannabinol (THC)

**Answer: C.** The immunoassay screen for cocaine detects its metabolite, benzoyllecgonine. Unlike immunoassays for amphetamines, benzodiazepines, phencyclidine, and THC, which may be highly unreliable, inconsistent, or nonspecific, the immunoassay for benzoyllecgonine does not typically result in false-positives or false-negatives. Detection of benzoyllecgonine is a specific indication of cocaine use in the past 3 days.

**150.4.** Which of the following mushroom species has hepatotoxic but not hallucinogenic properties?

- A. *Amanita muscaria*
- B. *Amanita pantherina*
- C. *Amanita phalloides*
- D. *Conocybe smithii*
- E. *Psilocybe cubensis*

**Answer: C.** *A. phalloides* mushrooms do not have hallucinogenic properties. Their toxicity is mainly hepatic due to a number of cyclopeptide toxins contained in all parts of the mushroom. *C. smithii* and *P. cubensis* contain psilocybin and psilocin tryptamines. *A. muscaria* and *A. pantherina* contain the isoxazole compounds ibotenic acid and muscimol, which are analogues of glutamic acid (excitatory) and  $\gamma$ -aminobutyric acid (GABA; inhibitory) neurotransmitters, respectively.

## KEY CONCEPTS

- Asymptomatic patients seeking ED care for an abnormal metal test need follow-up evaluation arranged with a medical toxicologist.
- Metal testing in the ED should only be ordered in consultation with a medical toxicologist or regional poison center.
- Acute ingestion of the salts of most metals causes rapid severe gastrointestinal pain and emesis.
- Any abnormal neurologic signs in a patient with any metal exposure warrants admission for further evaluation and chelation therapy.
- Acute iron poisoning can result in gastrointestinal symptoms, metabolic acidosis, and hepatotoxicity. Serum iron levels at 3 and 6 hours after ingestion determine toxicity and need for therapy.
- The chelation agent of choice for severe iron poisoning is deferoxamine and is indicated for peak serum iron concentrations greater than 500  $\mu\text{g}/\text{dL}$  and patients with severe signs and symptoms regardless of the iron level.
- The most important intervention for lead poisoning is removal from the source of exposure.
- The gastrointestinal decontamination method of choice for iron and lead toxicity with radiographic presence of pills or paint chips is WBI.
- The chelation agent of choice for acute arsenic poisoning is intramuscular British anti-lewisite (BAL) or oral succimer.
- Elemental mercury is nontoxic to the gastrointestinal tract but may cause pulmonary and CNS toxicity from inhalation of volatilized vapors.

## CHAPTER 151: QUESTIONS &amp; ANSWERS

**151.1.** Which of the following laboratory tests is most useful in a suspected iron overdose?

- A. Aspartate aminotransferase
- B. Ferritin
- C. Serum iron
- D. Total iron-binding capacity (TIBC)
- E. Transferrin

**Answer: C.** The serum iron level is most helpful when it is measured at its peak, 3 to 5 hours after ingestion, and is the most useful to predict toxicity. Levels below 350  $\mu\text{g}/\text{dL}$  are generally safe, whereas levels above 500  $\mu\text{g}/\text{dL}$  indicate the potential for severe toxicity. At levels in between, the severity of the symptoms guides treatment.

**151.2.** A 20-year-old man presents after an iron overdose. An abdominal radiograph shows many radiopaque objects in his stomach, consistent with iron tablets. You decide to try to decrease the gastrointestinal absorption of the iron. Which of the following methods is most effective?

- A. Activated charcoal
- B. Gastric lavage
- C. Surgical removal
- D. Syrup of ipecac
- E. Whole bowel irrigation (WBI)

**Answer: E.** WBI is the preferred method to minimize iron absorption. WBI should not be routinely used in small overdoses or with mild symptoms, but it should be considered when a significant ingestion is suspected or when multiple tablets are identified by radiography. Iron is not adsorbed to activated charcoal. Gastric lavage and syrup of ipecac do not remove significant amounts of iron. Open surgical removal of tablets has been used in the past and is effective, but it is obviously invasive and has a higher rate of adverse outcomes than WBI.

**151.3.** A 5-year-old boy presents with abdominal pain, nausea, vomiting, and bloody diarrhea. The boy was found rummaging through his grandmother's medicine cabinet and may have ingested some of her medications. His vital signs are significant for hypotension and tachycardia. An electrocardiogram (ECG) shows only sinus tachycardia. Laboratory tests are significant for an anion gap acidosis, hyperglycemia, and moderate leukocytosis. Which of the following medications did he most likely ingest?

- A. Digoxin
- B. Diltiazem
- C. Iron
- D. Metformin
- E. Metoprolol

**Answer: C.** Iron toxicity typically presents with gastrointestinal symptoms including occasional bleeding soon after ingestion. The previously mentioned laboratory findings are also typical. Digoxin toxicity can also be manifested with gastrointestinal symptoms, but there is usually no gastrointestinal bleeding and there are also typically ECG changes. Beta-blocker toxicity, such as with metoprolol, is manifested with hypotension and bradycardia, as well as with hypoglycemia. Calcium channel blocker toxicity, such as with diltiazem, can be manifested with gastrointestinal symptoms, acidosis, and hyperglycemia. However, patients typically have bradycardia, and gastrointestinal bleeding is not expected. Met

formin toxicity is manifested with gastrointestinal upset, typically without bleeding. Lactic acidosis can result, but the vital sign abnormalities and other laboratory results are not expected.

**151.4.** A 45-year-old man presents with difficulty walking and fatigue. His vital signs are normal. His physical examination is significant for pale conjunctiva and a foot-drop. Serum electrolyte values are normal. A complete blood count is significant for a hypochromic anemia. Which of the following metals is most consistent with these findings?

- A. Arsenic
- B. Iron
- C. Lead
- D. Mercury
- E. Tin

**Answer: C.** Lead principally affects the hematopoietic, neurologic, and renal systems. Typically, there is a hypochromic or normochromic anemia. Peripheral neuropathies can occur and often result in a wristdrop or footdrop. Lead also causes neuropsychiatric changes. Arsenic typically affects the gastrointestinal, cardiovascular, respiratory, and renal systems. Iron typically affects the gastrointestinal system and causes liver and heart failure. Mercury often affects the neurologic, gastrointestinal, and renal systems. Tin does not have significant toxicity in humans.

**151.5.** Which of the following laboratory tests would you expect to have an abnormal result in a child with the radiograph shown here.

- A. Calcium
- B. Iron
- C. Lead
- D. Mercury
- E. Parathyroid hormone

**Answer: C.** This radiograph illustrates "lead lines," which indicate increased metaphyseal activity. This finding is common in children suffering from chronic lead exposure.

**151.6.** A 24-year-old man presents after attempting suicide by ingesting approximately 10 g of mercury that he collected from thermometers. The ingestion occurred approximately 30 minutes ago. He has no complaints currently. His vital signs and physical examination findings are normal. An abdominal radiograph reveals a radiopaque mass in his epigastrium. Other than psychiatry consultation, what treatment is indicated?

- A. Dimercaprol
- B. Hemodialysis
- C. No treatment
- D. Succimer
- E. Whole bowel irrigation (WBI)

**Answer: C.** Ingested metallic mercury is poorly absorbed and poses no health risk as long as it is passed from the body and not trapped in the appendix or a diverticulum. Inorganic mercury salts are quite toxic, and patients exposed to these should be treated with succimer or dimercaprol. Organic mercury is typically not acutely toxic but does cause significant chronic disability and should be treated with succimer because treatment with dimercaprol can actually increase levels of mercury in the central nervous system (CNS). Hemodialysis is not effective.



## KEY CONCEPTS

- Aspiration is the major toxic risk of hydrocarbon poisoning.
- Hydrocarbons may cause systemic toxicity, burns, seizures, cardiac dysrhythmias, and altered mentation depending upon agent.
- Gastrointestinal decontamination is potentially harmful in cases of hydrocarbon ingestion and is contraindicated.
- Hydrocarbon inhalant abuse can cause CNS and cardiotoxic effects.
- Symptoms of toxicity, especially aspiration, can be delayed, so asymptomatic patients should be observed for 6 hours and given clear instructions to return if symptoms develop after discharge.
- In most cases of hydrocarbon ingestion or inhalation, symptomatic care along with close observation and monitoring are the cornerstones of management. Currently, there are no specific antidotes for hydrocarbons. Patients who have or develop pulmonary symptoms should have a chest radiograph performed.

## CHAPTER 152: QUESTIONS &amp; ANSWERS

**152.1.** Hydrocarbons can affect many organ systems, but derangements in which organ system most commonly lead to death after hydrocarbon exposure?

- A. Cardiac
- B. Gastrointestinal
- C. Nervous
- D. Pulmonary
- E. Renal

**Answer: D.** Most fatalities from hydrocarbon ingestion occur because of aspiration. Hydrocarbons cause direct lung injury, as well as displace oxygen and disrupt surfactant. Hydrocarbons can sensitize the myocardium to catecholamines, which can result in ventricular dysrhythmias and sudden death. Although an important consideration, death is more frequently caused by pulmonary complications. Gastrointestinal complications from hydrocarbon exposure are rare unless related to aspiration potential. Chronic hydrocarbon abuse or exposure causes nervous system dysfunction, including peripheral neuropathy, cerebellar degeneration, and neuropsychiatric disorders, but typically do not result in death. Several hydrocarbons cause renal failure, particularly toluene, but rarely result in death.

**152.2.** A healthy 20-year-old man presents after accidentally ingesting furniture polish that was stored in a plastic container that he mistook for a beverage. The ingestion occurred approximately 1 hour ago. He has no complaints. His vital signs and physical examination are normal. Which is the most appropriate course of action?

- A. Carbon monoxide level
- B. Careful gastric decontamination using nasogastric tube
- C. Drug screen
- D. Observe for 6 hours and discharge if condition does not change
- E. Serum electrolytes

**Answer: D.** Furniture polish is typically a mixture of nontoxic chemicals with a hydrocarbon base. The primary toxicity from hydrocarbon is from aspiration. Gastric decontamination is not recommended. Serum electrolytes and drug screens are rarely helpful in acute asymptomatic hydrocarbon exposures. Wood strippers often contain methylene chloride, which can cause carbon monoxide poisoning, but this chemical is not found in furniture polish.

**158.3.** A 4-year-old boy with a history of asthma is brought to the emergency department (ED) following an accidental hydrocarbon ingestion 2 hours ago. He initially was noted to be coughing. His vital signs are normal. His physical examination reveals mild bilateral wheezing but with good air movement. His oxygen saturation is 99% on room air. A chest radiograph is normal. The child is placed on a cardiac monitor and intravenous (IV) access is obtained. What is the most appropriate treatment plan?

- A. Admission and observation
- B. Endotracheal intubation
- C. Intravenous sodium bicarbonate
- D. Nebulized albuterol
- E. Oral activated charcoal

**Answer: A.** Hydrocarbons cause few symptoms when in the gastrointestinal tract, but they can be fatal when aspirated. Any therapy that risks inducing vomiting should be avoided (ie, gastric lavage and oral activated charcoal). This child likely has aspirated hydrocarbon and, although stable, could benefit from admission and observation. Endotracheal intubation may be warranted if symptoms worsen. Sodium bicarbonate has no role in hydrocarbon toxicity. Albuterol and other catecholamines can theoretically increase the possibility of ventricular dysrhythmias after hydrocarbon ingestion due to cardiac sensitization.

**158.4.** A 16-year-old male presents by emergency medical services (EMS) paramedics with sudden cardiopulmonary arrest after found unresponsive by friends at a high school beach party. In the emergency department (ED), he is unresponsive with no gag reflex. When you attempt to orally intubate the patient, you note gold metallic colorations inside his oral cavity. What else are you immediately concerned about clinically?

- A. Airway obstruction from anaphylactic shock
- B. Cardiac arrest from ventricular dysrhythmias
- C. Sedative hypnotic toxicity and respiratory arrest
- D. Toxic alcohol poisoning and acute renal failure
- E. Traumatic intracranial hemorrhage

**Answer: B.** This adolescent has likely abused a hydrocarbon (such as, toluene from gold spray paint) for recreational and euphoric reasons. Aside from pulmonary toxicity from aspiration pneumonitis, you are concerned about the possibility of direct cardiotoxicity from the inhaled hydrocarbon resulting in ventricular dysrhythmias and cardiac arrest.



## KEY CONCEPTS

- An asphyxiant is any gas that displaces sufficient oxygen from the breathable air. Treatment consists of removal from exposure, supplemental oxygen, and supportive care.
- Highly water-soluble gases produce rapid irritation and predominantly upper respiratory tract symptoms, such as airway irritation. Poorly water-soluble gases often produce delayed lower respiratory tract findings, such as bronchospasm or acute respiratory distress syndrome (ARDS).
- CO poisoning is confirmed by co-oximetry measurement. Cyanide poisoning is treated empirically when cardiovascular instability (eg, hypotension), altered mental status, or a serum lactate greater than 10 mmol/L are present in a fire victim.
- Hydroxocobalamin is the preferred antidote for most cyanide poisoned patients due to its efficacy, ease of use, and safety in patient with concomitant CO poisoning. Sodium thiosulfate may be administered concomitantly and may provide additional benefit.
- Patients with hydrogen sulfide poisoning generally respond to removal from exposure and ventilatory support.
- Normobaric oxygen therapy is sufficient for many patients with CO poisoning, but we recommend consultation with a hyperbaric oxygen (HBO) facility, poison control center, or medical toxicologist for consideration of HBO therapy for patients with a COHb greater than 25% or any new neurologic or cardiovascular abnormality.

## CHAPTER 153: QUESTIONS &amp; ANSWERS

**153.1.** A laboratory worker is brought to the emergency department (ED) after being found unconscious. His colleague reports that the patient was found with his oxygen mask off while working in a room filled with carbon dioxide. The patient is now awake but reports feeling tired and confused. He has no other complaints. His vital signs and physical examination are normal. What toxin-specific diagnostics test should be ordered for this patient?

- A. Carboxyhemoglobin (COHb)
- B. Chest radiograph
- C. Electrocardiogram
- D. Methemoglobin (MetHb)
- E. No tests are indicated

**Answer: E.** Carbon dioxide is primarily a simple asphyxiant, meaning that its major consequential adverse effects stem from its displacement of oxygen in the lungs. Once patients are removed from the source, they generally recover completely. Patients should be observed until this time. COHb measurement would be indicated if there is a suspicion of carbon monoxide (CO) exposure. Chest radiographs should be ordered if patients have pulmonary complaints after an unknown exposure. Electrocardiograms should be ordered if patients are exposed to known cardiac toxins. MetHb levels should be checked when there is suspicion for oxidative stress on the red blood cells.

**153.2.** A 32-year-old woman presents following exposure to an irritant gas at her job site. She reports cough, burning eyes, and shortness of breath. She has mild tachypnea, with the remainder of her vital signs within normal limits. Her oxygen saturation is 96% on room air. She is noted to have stridor on physical examination. What is the preferred method to evaluate her upper airway symptoms?

- A. Arterial blood gas (ABG)
- B. Chest radiograph
- C. Computed tomography of the neck
- D. Fiberoptic laryngoscopy
- E. Soft tissue neck radiograph

**Answer: D.** Fiberoptic or direct laryngoscopy is the preferred method to evaluate upper airway symptoms after exposures to irritant gases. Radiographs and laboratory tests have no role and

should not influence the decision to provide a definitive airway. Symptoms can progress rapidly, so patients with upper airway symptoms require either placement of a definitive airway or close observation with frequent serial examinations.

**153.3.** A 52-year-old man is brought to the emergency department (ED) after being rescued from a house fire. He has not suffered any cutaneous burns. He complains of a sore throat, hoarse voice, and cough. Vital signs are normal. Physical examination reveals soot in his oropharynx and carbonaceous sputum. What therapy should be instituted first?

- A. Endotracheal intubation
- B. Intravenous (IV) methylprednisolone
- C. Nebulized albuterol
- D. Nebulized sodium bicarbonate
- E. Saline bronchoalveolar lavage

**Answer: A.** Endotracheal intubation should be performed early in patients with signs and symptoms of significant airway burns (as this patient has). Corticosteroids are not beneficial and can worsen associated injuries. Inhaled beta-agonists are commonly used, but there is no evidence of improved outcome. Inhaled sodium bicarbonate plays no role in the management of smoke inhalation. Bronchoalveolar lavage can be performed if there is suspicion of inhaled debris or toxins, but the airway should first be secured.

**153.4.** A 47-year-old woman is brought to the emergency department (ED) after being rescued from a house fire. She was found unconscious at the scene and intubated before arrival. Her vital signs are significant for hypotension and tachycardia. Physical examination is significant for soot in the oropharynx. No cutaneous burns are noted. You suspect that she is suffering from cyanide poisoning. What is the most appropriate immediate therapy?

- A. Hyperbaric oxygen (HBO)
- B. Intravenous (IV) hydroxocobalamin
- C. IV methylene blue
- D. IV sodium nitrite
- E. Observation and supportive care

**Answer: B.** One of the two major treatments for cyanide poisoning is hydroxocobalamin (the other is the cyanide antidote kit). The nitrite compounds in the cyanide antidote kit convert hemoglobin to methemoglobin (MetHb), which in turn binds to cyanide. However, nitrites produce hypotension and the MetHb prevents proper oxygen delivery, which may compound the reduction in oxygen delivery associated with carbon monoxide (CO) poisoning. HBO has no role in acute cyanide poisoning. Methylene blue has been used for cyanide poisoning in the past but is not as useful as the cyanide kit. Its primary use is in treating methemoglobinemia. General supportive care is not appropriate because there is an antidote for this patient's poisoning.

- 153.5. A 22-year-old man is brought to the emergency department (ED) after being found unconscious in a car with an intentionally prominent suicide note visible in the window. By the time he arrives in the ED, he has regained consciousness and is complaining of headache and nausea. Paramedics report that the car engine was not running when the patient was discovered. His vital signs and physical examination are normal. Which of the following therapies should be instituted?
- A. Hyperbaric oxygen (HBO)
  - B. Intravenous (IV) methylene blue
  - C. IV sodium nitrite
  - D. IV sodium thiosulfate
  - E. Observation and supportive care

**Answer: E.** This patient has been exposed to hydrogen sulfide (a common form of suicide in some parts of the world), which has similar effects on the mitochondria as cyanide. However, hydrogen sulfide is rapidly removed from the body; and as long as patients are recovering, removal from the source is usually all that is necessary. HBO and methylene blue have no role in hydrogen sulfide poisoning. Sodium nitrite can be used in patients who are not recovering once removed from the source or for severe exposures. Sodium thiosulfate is not necessary because hydrogen sulfide is detoxified by a different pathway than cyanide and does not need a sulfur donor.

- 153.6. A 51-year-old man is brought to the emergency department (ED) after being found unconscious and was intubated by emergency medical services (EMS) before arrival. His vital signs reveal hypotension but are otherwise normal. His physical examination is nonspecific. On 100% oxygen by endotracheal tube, his pulse oximetry reveals 100% saturation. Results of an arterial blood gas (ABG) are pH 7.05, partial pressure of carbon dioxide ( $P_{CO_2}$ ) 27 mm Hg, and partial pressure of oxygen ( $P_{O_2}$ ) 65 mm Hg. Which one of these findings is inconsistent with simple carbon monoxide (CO) poisoning?
- A. Hypotension
  - B. Oxygen saturation 100%
  - C.  $P_{CO_2}$  27 mm Hg
  - D. pH 7.05
  - E.  $P_{O_2}$  65 mm Hg

**Answer: E.** Measurement of oxygen saturation and  $P_{O_2}$  values is complicated in CO poisoning. Carboxyhemoglobin (COHb) is essentially falsely read as oxyhemoglobin by pulse oximeters, so a high oxygen saturation is expected by pulse oximetry.  $P_{O_2}$  is a measurement of dissolved oxygen in the blood; this result is independent of CO exposure and is not useful in determining whether CO poisoning is present; thus it should be normal. Metabolic acidosis with an elevated lactate is common because CO impairs aerobic metabolism; respiratory compensation is appropriate.

- 153.7. What is the major benefit of hyperbaric oxygen (HBO) therapy for patients suffering from carbon monoxide (CO) poisoning?
- A. Decreased rate of hospitalization
  - B. Improvement of 24-hour mortality
  - C. Improvement of 30-day mortality
  - D. Prevention of delayed cardiovascular complications
  - E. Prevention of delayed neuropsychiatric complications

**Answer: E.** There is controversy regarding the role of HBO therapy for patients with CO poisoning, but the best evidence suggests that it can significantly decrease the incidence of delayed neuropsychiatric complications. There is no change in rate of hospitalization, nor on overall mortality, either short term or long term. There are no delayed cardiovascular symptoms associated with CO poisoning.

- 153.8. Assuming that all patients have similar vital signs and complaints of headache and nausea, which of the following patients suffering from carbon monoxide (CO) poisoning should be considered highest priority for hyperbaric oxygen (HBO) therapy?
- A. A 22-year-old otherwise healthy man with a carboxyhemoglobin (COHb) level of 30%
  - B. A 25-year-old otherwise healthy pregnant woman with a COHb level of 25%
  - C. A 30-year-old otherwise healthy man also suffering from cyanide poisoning with a COHb level of 15%
  - D. A 35-year-old otherwise healthy woman with second-degree burns to 20% of her body and with a COHb level of 20%
  - E. A 67-year-old asymptomatic woman with coronary artery disease and with a COHb level of 25%

**Answer: B.** Pregnant patients should be considered for HBO therapy. CO binds more strongly to fetal hemoglobin than to adult hemoglobin and can cause severe hypoxia to the fetus. There is controversy about an absolute level of COHb that requires HBO therapy. HBO does not benefit cyanide victims, nor is it indicated in uncomplicated burn patients or those with stable comorbidities.

## KEY CONCEPTS

- The clinical pattern of acute and chronic toxicity is different. Gastrointestinal symptoms occur early and neurological toxicity manifest late in acute toxicity. Neurological findings (such as, tremors, clonus, and somnolence) often are presenting signs of chronic lithium toxicity and gastrointestinal symptoms may be absent.
- Neither activated charcoal nor whole bowel irrigation (WBI) is indicated in the routine management of acute or chronic lithium toxicity.
- Serial lithium concentrations should be obtained every 2 to 4 hours initially to determine the peak level and the need for dialysis.
- Fluid hydration with crystalloid is essential to enhance the removal of lithium through the kidney. Diuretics are contraindicated.
- We recommend dialysis for acute lithium concentrations  $>4$  mEq/L, and chronic lithium concentrations  $>2.5$  mEq/L, or for patients with signs of severe neurological toxicity regardless of the concentration.

## CHAPTER 154: QUESTIONS &amp; ANSWERS

**154.1.** What are the two most common electrolyte abnormalities seen in chronic lithium toxicity—hypernatremia and hypercalcemia?

- A. Hyperkalemia
- B. Hyponatremia
- C. Hypokalemia
- D. Hypomagnesemia
- E. Hyponatremia and hypercalcemia

**Answer: E.** Hyponatremia and hypercalcemia are frequently seen in cases of acute lithium overdose. Chronic lithium use can cause hyponatremia.

**154.2.** Which of the following conditions is most frequently seen in patients with chronic lithium use?

- A. Anticholinergic syndrome
- B. Diabetes insipidus
- C. Hyperthyroidism
- D. Hypoparathyroidism
- E. Syndrome of inappropriate antidiuretic hormone

**Answer: B.** Diabetes insipidus commonly occurs in patients on chronic lithium therapy or with chronic overdose. Diabetes insipidus can cause dehydration and a further increase in lithium concentration and is a frequent contributory cause to chronic lithium toxicity. Rarely, hypothyroidism can also develop. Lithium use is also associated with neuroleptic malignant syndrome and serotonin syndrome but none of the other listed conditions.

**154.3.** Which of the following drugs should be used with caution in patients taking lithium?

- A. Acetaminophen
- B. Hydrochlorothiazide
- C. Metformin
- D. Metoprolol
- E. Penicillin

**Answer: B.** Hydrochlorothiazide, other diuretics, angiotensin-converting enzyme (ACE) inhibitors, and nonsteroidal anti-

inflammatory drugs (NSAIDs) can increase lithium levels and consequently cause chronic lithium toxicity by interfering with renal elimination. Lithium has also been implicated in serotonin syndrome when combined with other drugs, such as monoamine oxidase (MAO) inhibitors, selective serotonin reuptake inhibitor (SSRIs), dextromethorphan, and meperidine. None of the other drugs listed causes significant interactions with lithium.

**154.4.** A 26-year-old woman presents following a witnessed seizure. She was found with an empty bottle of lithium and a suicide note. Her vital signs reveal hypotension and tachycardia. She is lethargic, and her only response is to withdraw from painful stimuli. The remainder of her physical examination is normal. Laboratory tests including a serum lithium level are pending. Which of the following treatments is the most appropriate?

- A. Activated charcoal
- B. Forced diuresis
- C. Hemodialysis
- D. Urinary alkalinization
- E. Whole bowel irrigation (WBI)

**Answer: C.** Hemodialysis is the most effective way to remove lithium. It can remove lithium at a rate five to seven times the rate of typical renal elimination. Common indications for dialysis include decreased level of consciousness and seizures. Activated charcoal does not adsorb lithium. Lithium overdose patients are often dehydrated and occasionally hyponatremic and should be fluid resuscitated, but once dehydration is corrected, forced diuresis is of no benefit and can be detrimental. Similarly, urinary alkalinization causes more harm than good and should be avoided. Because this patient has already experienced a seizure, the administration of WBI is not advised. In addition, the seizure suggests that the brain concentration of lithium is already toxic and this is not improved by WBI.

## KEY CONCEPTS

- Extrapyramidal syndromes are a common complication of antipsychotic medications. First line treatment is benztropine or diphenhydramine. Lorazepam is used in refractory cases.
- The most common finding in antipsychotic overdose is CNS depression. Treatment centers on supportive care, airway management, and cardiac monitoring.
- QT prolongation and torsades de pointes are potential complications of many antipsychotic medications in overdose and can also occur with therapeutic doses.
- Clozapine is associated with potentially life-threatening agranulocytosis. Treatment includes stopping the drug, treating infections, and supportive care.
- The neuroleptic malignant syndrome (NMS) is characterized by altered mental status, hyperthermia, muscle rigidity, and autonomic instability. Supportive care includes airway management, benzodiazepines, treatment of muscular rigidity, and evaporative cooling.

## CHAPTER 155: QUESTIONS &amp; ANSWERS

**155.1.** A 24-year-old man presents with cough and fever. He has schizophrenia for which he takes haloperidol. You diagnose him with community-acquired pneumonia. Which of the following antibiotics could cause a life-threatening arrhythmia if administered to this patient?

- A. Amoxicillin/clavulanic acid
- B. Azithromycin
- C. Cefpodoxime
- D. Clindamycin
- E. Doxycycline

**Answer: B.** Antipsychotics can cause QT prolongation, so other drugs that cause QT prolongation should be avoided. Macrolides, fluoroquinolones, and trimethoprim-sulfamethoxazole are common antibiotics that can all cause QT prolongation.

**155.2.** A 42-year-old man presents complaining that his neck is turned to the right. He states he cannot move his head and his neck hurts. He denies trauma and states that this has never happened before. He has schizophrenia but does not recall the names of his medications. His vital signs are normal and examination reveals palpable spasm of the right trapezius and sternocleidomastoid muscles. What is the most appropriate treatment?

- A. Bromocriptine
- B. Cyclobenzaprine
- C. Diphenhydramine
- D. Morphine
- E. Prochlorperazine

**Answer: C.** This patient has an acute dystonic reaction to an antipsychotic medication best treated with an anticholinergic medication, such as diphenhydramine or benztropine. Bromo-

riptine is a dopamine agonist used to treat pituitary disorders and can worsen psychosis. Cyclobenzaprine can be used for typical muscle spasms but will not significantly improve acute dystonia. Morphine may help but does not resolve the underlying problem. Prochlorperazine is an antipsychotic that can induce acute dystonic reactions and should be avoided in this patient.

**155.3.** A 22-year-old man is brought to the emergency department (ED) by family because of a change in mental status. They report that 2 days ago the patient had his psychiatric medications adjusted and has been confused since then. The patient's vital signs are: blood pressure, 162/100 mm Hg; heart rate, 143 beats/min; respiratory rate, 22 breaths per minute; and temperature, 40.1° C. On physical examination, the patient is found to have muscle rigidity. Laboratory tests are pending. Intravenous (IV) access is obtained, and crystalloid fluids are started. Cool mist and fans are applied to the patient. What additional therapy is indicated?

- A. Acetaminophen
- B. Cyproheptadine
- C. Dantrolene
- D. Diphenhydramine
- E. Lorazepam

**Answer: E.** Lorazepam or another benzodiazepine is indicated in neuroleptic malignant syndrome (NMS). Acetaminophen plays no role in treating the hyperthermia, which should be treated with active cooling measures. Cyproheptadine can be used in serotonin syndrome but does not improve NMS. Dantrolene can be used in malignant hyperthermia but does not improve NMS. Diphenhydramine is used for acute dystonia and does not affect the course of NMS.

## KEY CONCEPTS

- The opioid toxidrome includes three prominent findings—CNS depression, miosis, and most importantly, respiratory depression—but presentations may be variable.
- A negative urine screen is unreliable, and absence of detection should not deter a diagnosis of opioid intoxication when clinical findings support it.
- Airway protection, oxygenation, ventilation, and early administration of naloxone are the cornerstones for management of patients with opioid toxicity.
- The duration of action of many opioids, especially after overdose, is significantly longer than that of naloxone. Patients responsive to naloxone should be observed for recurrence of respiratory depression, because they may require further doses of naloxone.
- Community naloxone programs and prescription drug monitoring programs are two new ways in which the medical profession is trying to curb the epidemic of opioid-related deaths.
- Opioid withdrawal syndrome does not include altered cognition. Patients with known or suspected opioid withdrawal who also have altered cognition should be evaluated for another cause of the altered cognition.

## CHAPTER 156: QUESTIONS &amp; ANSWERS

- 156.1.** Most opioids cause mild hypotension related to histamine release and bradycardia. Which of the following opioids can also cause sodium channel blockade and QRS widening?
- Hydromorphone
  - Meperidine
  - Morphine
  - Oxycodone
  - Propoxyphene

**Answer: E.** Propoxyphene and its metabolite norpropoxyphene can cause QRS widening. None of the other listed opioids has significant effects on the cardiac conduction system.

- 156.2.** Which of the following laboratory abnormalities is most commonly seen in opioid overdose?
- Hypocalcemia
  - Hypochloremia
  - Hypoglycemia
  - Hypokalemia
  - Hyponatremia

**Answer: C.** Hypoglycemia is the only consistent laboratory abnormality found in opioid overdose. It is generally mild but can contribute to the decreased level of consciousness seen in opioid overdose.

- 156.3.** A 32-year-old man presents with confusion, nausea, vomiting, diarrhea, and abdominal pain. His friends report that he is withdrawing from heroin. Vital signs reveal mild hypertension, tachycardia, and tachypnea. Physical examination is significant for confusion, mydriasis, diaphoresis, lacrimation, piloerection, and mild diffuse abdominal tenderness. Which of the following signs and symptoms makes you concerned that this may not be a simple opioid withdrawal case?
- Confusion
  - Diarrhea
  - Mydriasis
  - Piloerection
  - Tachycardia

**Answer: A.** Opioid withdrawal almost always causes restlessness, agitation, and anxiety. Cognition and mental status are not affected in simple opioid withdrawal and, if present, should prompt the clinician to search for other causes instead of or in addition to withdrawal.

- 156.4.** A 20-year-old woman is brought to the emergency department (ED) after being found with decreased mental status at a club. Vital signs indicate mild hypotension and bradycardia. She is drowsy but arousable, and she has an otherwise normal physical examination. Upon receiving naloxone 2 mg IV, her mental status immediately improves and soon thereafter she vomits. She now reports nausea but has no other complaints. She states she took some “pain pills” to get high but does not know what they were. What diagnostics tests should be performed?
- Acetaminophen
  - Arterial blood gas
  - Chest radiograph
  - Lactate
  - Urine drug screen

**Answer: A.** Because many prescription opioid medications are combinations of an opioid and acetaminophen, ibuprofen, or salicylate, concentrations of acetaminophen and salicylate should also be ordered. Acetaminophen overdose might otherwise remain undiagnosed but, if identified, can be treated with an existing antidote, *N* acetylcysteine. The chest radiograph is not indicated unless a pulmonary complication is suspected. Lactate and a urine drug screen would not change patient management.

- 156.5.** Which of the following medications can be used to treat opioid withdrawal?
- Clonidine
  - Dextromethorphan
  - Diphenhydramine
  - Nalmefene
  - Valproic acid

**Answer: A.** Clonidine suppresses the sympathetic hyperactivity of opioid withdrawal. Dextromethorphan is an opioid derivative used as a cough suppressant, but it does not treat the symptoms of opioid withdrawal. Diphenhydramine and valproic acid have no role in opioid withdrawal. Nalmefene is an opioid antagonist similar to naloxone but with a longer duration of action. Administration of nalmefene would worsen opioid withdrawal symptoms.



**156.6.** A 14-month-old child is brought to the emergency department (ED) 4 hours after he was found with his grandmother's antidiarrheal medication bottle. A pill count identifies that only one Lomotil tablet is missing. The child is playful, has a normal respiratory rate and pattern, and has a soft abdomen with normal bowel sounds. Appropriate management includes which of the following?

- A. Administration of activated charcoal
- B. Administration of naloxone
- C. Admission to a monitored unit
- D. Discharge home
- E. Gastric lavage

**Answer: C.** Activated charcoal and gastric lavage are means of gastrointestinal decontamination and are not routinely recommended in opioid toxicity. Opioid intoxicated patients with central nervous system (CNS) and respiratory depression should be treated with naloxone, but asymptomatic patients do not require antidote administration. Asymptomatic patients with known or suspected Lomotil (diphenoxylate/atropine) ingestion should be observed in a monitored setting for delayed onset of toxicity from the metabolite of diphenoxylate.

**156.7.** An 18-year-old male is driven to the emergency department (ED) by friends and carried into the triage area. He has agonal respirations and is cyanotic. Immediate resuscitative measures include bag-valve-mask (BVM) ventilation, establishment of an intravenous (IV) line, and administration of 0.4 mg of naloxone. The patient's respiratory status improves and although sleepy, he is able to answer some questions. During subsequent monitoring, the patient's respiratory status again declines, and he requires two additional doses of naloxone. Additional treatment should include which of the following?

- A. Nalmefene
- B. Naloxone infusion
- C. Hemodialysis
- D. Suboxone
- E. Subutex

**Answer: B.** This patient likely has toxicity from a long-acting opioid agent, and a continuous infusion of naloxone will be necessary for ongoing reversal of toxicity. Nalmefene is a longer-acting opioid antagonist but is not preferred over naloxone infusion because naloxone allows for dose titration. Suboxone and Subutex are agonist agents used in the treatment of withdrawal. Opioids are not dialyzable due to large volumes of distribution.

**156.8.** A 26-year-old female is brought to the emergency department (ED) from the local airport by law enforcement. She is sleepy and mumbles incoherently in a foreign language. Vital signs include the following: blood pressure, 104/66; respiratory rate, 14 breaths per minute; and temperature, 98.6° F. Which of the following tests might identify the cause of this patient's symptoms?

- A. Abdominal radiograph
- B. Electrocardiogram (ECG)
- C. Electroencephalogram (EEG)
- D. Head computed tomography (CT)
- E. Urine drug screen

**Answer: A.** An abdominal radiograph would likely reveal multiple packets of illicit opioid in the gastrointestinal tract of this body packer. One or more of the packets has leaked, producing the opioid toxicity. A urine drug screen may not identify an opioid but would not identify the internal packets. A head computed tomography (CT) scan would not be helpful unless associated head trauma is suspected. An EEG and ECG would not provide specific information to identify the internal packets.

## KEY CONCEPTS

- Organophosphates cause symptoms by accumulation of acetylcholine.
  - Treat cholinergic symptoms with atropine.
  - Reverse the inhibition of acetylcholinesterase with oximes.
- Aging, which results in prolonged toxicity, occurs with organophosphate poisoning, but not with carbamates.
- Chlorinated hydrocarbons can present with seizures and cardiac toxicity.
- Substituted phenols are found in weight loss products and exert their toxicity by uncoupling oxidative phosphorylation.
  - They can cause cardiac, liver, and renal injury.
- Chlorophenoxy compounds cause muscular injury.
  - Measure creatinine kinase; assess for acute rhabdomyolysis, kidney injury, and liver injury.
- Bipyridyl compounds cause pulmonary and renal injury.
  - Paraquat concentrates in lungs; limit supplemental oxygen therapy, because this will exacerbate pulmonary toxicity.
- Diquat causes renal injury.
- Pyrethrins and pyrethroids cause local dermatologic symptoms.
- Glyphosate
  - Acute toxicity is likely related to the surfactant included in the product.
- DEET should not be used in infants younger than 2 months old.
- DEET in concentrations of more than 30% should not be used in children and may result in neurotoxicity and self-limited seizure activity if used in excessive amounts.
- Most rodenticide exposures will be superwarfarin compounds.
  - For large exposures, INR should be checked at a minimum of 2 days after ingestion.
- Vitamin K should be used for reversal; blood products should be used for active bleeding.

## CHAPTER 157: QUESTIONS &amp; ANSWERS

**157.1.** A 37-year-old man arrives at the emergency department (ED) after exposure to an organophosphate. He is severely symptomatic, and atropine is given. When should atropine treatment be discontinued?

- A. After 100 mg has been given
- B. When fasciculations stop
- C. When mydriasis occurs
- D. When secretions have stopped
- E. When tachycardia occurs

**Answer: D.** Patients with organophosphate poisoning may require very large doses of atropine (up to 500 mg). Proper dosing is 1 or 2 mg intravenously with doubling of the dose every 5 minutes until the drying of secretions. Atropine has no effect at the neuromuscular junction. Mydriasis may occur before secretions have dried. Tachycardia is likely, but it is not a contraindication for continued atropine treatment. The tachycardia often improves as the pulmonary status improves.

**157.2.** A 30-year-old agricultural worker arrives at the emergency department (ED) with confusion, abdominal pain, nausea, vomiting, and shortness of breath. His coworkers report that he was spraying plants with an insecticide. The patient's vital signs are significant for hypotension, bradycardia, and tachypnea. Physical examination reveals miosis, wheezing, vomiting, diarrhea, and urinary incontinence. Which of the following combinations of medications should be given to this patient?

- A. Atropine and cyproheptadine
- B. Atropine and physostigmine
- C. Atropine and pralidoxime
- D. Cyproheptadine and physostigmine
- E. Physostigmine and pralidoxime

**Answer: C.** This patient has symptoms of the cholinergic syndrome (SLUDGE symptoms) and was likely exposed to an organophosphate or carbamate pesticide. Treatment for organophosphate and carbamate poisoning includes atropine to reverse the cholinergic effects and pralidoxime to restore cholinesterase activity. (Pralidoxime use for carbamate poisoning is controversial, but because it is often unclear what exact pesticide was used, treatment with pralidoxime is generally recommended.) Cyproheptadine is an antihistamine that can be used in serotonin syndrome. Physostigmine can be used as an antidote in anticholinergic syndrome.

**157.3.** A 4-year-old boy arrives at the emergency department (ED) after drinking a medication that was being used to

treat his sister's head lice. An unknown amount was consumed, and the bottle is not available. The patient's only complaint is of nausea. Vital signs and physical examination findings are normal. Which of the following symptoms should be anticipated?

- A. Gastrointestinal hemorrhage
- B. Hallucinations
- C. Hypotension
- D. Paralysis
- E. Seizure

**Answer: E.** Lindane is a chlorinated hydrocarbon insecticide that is used for the topical treatment of head lice and scabies. It is rapidly absorbed and can result in difficult-to-control seizures requiring high doses of benzodiazepines or barbiturates and that may require sedation, paralysis, and intubation. Because lindane is a hydrocarbon, it can sensitize the cardiac membrane and predispose to ventricular dysrhythmias. It can also cause pulmonary compromise if it is aspirated.

**157.4.** An 18-year-old woman arrives at the emergency department (ED) complaining of feeling generally weak. She reports reading online about a pesticide that can help in weight loss, and she has recently tried this. Her vital signs are: blood pressure, 110/70 mm Hg; heart rate, 121 bpm; respiratory rate, 22 rpm; and temperature, 104° F (40.0° C). Her physical examination reveals dry mucous membranes and yellow staining on her abdomen. Which of the following laboratory findings can you anticipate?

- A. Hypoglycemia
- B. Hypokalemia
- C. Hyponatremia
- D. Hypoxia
- E. Methemoglobinemia

**Answer: A.** Substituted phenols, such as dinitrophenol, are pesticides that uncouple oxidative phosphorylation. This causes an increased metabolism, which in turn consumes glucose and generates heat, often causing an increased body temperature. For this reason, they have been used as diet aids. They can be applied topically, and the yellow skin staining is pathognomonic for nitrogen compounds. Treatment is supportive and should be aimed at stopping further exposure; providing the needed substrates of oxygen, water, and glucose; and applying active cooling measures.

157.5. What organ system is most affected by paraquat ingestion?

- A. Cardiac
- B. Gastrointestinal
- C. Nervous
- D. Pulmonary
- E. Renal

**Answer: D.** Paraquat is concentrated in the lungs and directly damages the alveolar capillary membrane. This results in surfactant loss, adult respiratory distress syndrome, pulmonary fibrosis, and respiratory failure and is accelerated with supplemental oxygen. All the other organ systems listed are affected but to a much lesser degree.

157.6. A patient arrives at the emergency department (ED) after an intentional paraquat ingestion complaining of severe mouth, throat, and chest pain. What potentially fatal complication of paraquat ingestion should be suspected?

- A. Aortic dissection
- B. Esophageal rupture
- C. Myocardial infarction
- D. Pneumothorax
- E. Pulmonary embolism

**Answer: B.** Paraquat is extremely corrosive and can cause severe burns to the oropharynx, as well as to the esophagus. Frequently, esophageal rupture occurs, leading to mediastinitis and death. None of the other listed conditions occurs with any frequency in paraquat poisoning.

157.7. How do pyrethrins cause toxicity?

- A. Allergic reactions
- B. Bone marrow suppression

C. Cardiovascular instability

D. Inhibition of coagulation

E. Uncoupling of oxidative phosphorylation

**Answer: A.** Pyrethrins are naturally occurring substances from the yellow chrysanthemum and commonly cause allergic reactions in humans. These reactions can be mild or life-threatening with bronchoconstriction and laryngeal edema. They also affect gamma-aminobutyric acid (GABA)-mediated chloride channels in the nervous system, but this typically results in only a mild headache and paresthesias.

157.8. DEET is a commonly used insect repellent that can cause contact dermatitis and more severe neurologic complications, including seizures with high doses that are absorbed through the skin. Which of the following methods will minimize DEET absorption through the skin?

- A. Apply to skin at night
- B. Cover skin with clothing
- C. Expose skin to direct sunlight
- D. Keep skin dry
- E. Remove from skin with oil-based products

**Answer: D.** DEET absorption and toxicity increase with repeated applications, with increased ambient temperatures, with sweating, when it is applied to abraded or thin skin, and when it is covered with tight-fitting clothing. Oils or lipophilic substances applied to the skin also increase absorption of DEET.

## KEY CONCEPTS

- Most botanical exposures result in minimal toxicity and management is largely symptom-based, supportive care.
- Most serious toxicity results from exposure to plants with anticholinergic, antimitotic, cardiovascular, or convulsive properties.
- Most cases in which gastrointestinal (GI) symptoms begin within the first 2 hours after an unknown mushroom ingestion will prove to involve a non-life-threatening substance.
- GI symptoms that onset in more than 6 to 8 hours suggest a potentially life-threatening ingestion, such as the cyclopeptide and gyromitrin groups.
- Use local poison control centers, mycologists, and botanists to help identify serious plants and mushrooms that have been ingested. We recommend digital photography with expert consultation.
- Herbal medications are unregulated and may have inherent toxicity, herb-drug interactions, or contaminants. Clinicians should advise against the routine use of herbal medications.

## CHAPTER 158: QUESTIONS &amp; ANSWERS

- 158.1.** A 52-year-old man presents after ingestion of water hemlock complaining of nausea but no other symptoms. He reports that he ate the water hemlock in a suicide attempt but has since changed his mind. His vital signs and physical examination are normal. What is the most appropriate initial treatment of this patient?
- General seizure precautions
  - Hemodialysis
  - Neutralization with milk
  - Supportive care only
  - Whole bowel irrigation

**Answer: A.** Water hemlock is very toxic with fatality rates as high as 70%. Because this patient is at risk for seizures, oral activated charcoal and gastric lavage are contraindicated. Hemodialysis, whole bowel irrigation, and milk are not beneficial. Supportive care is not adequate with water hemlock ingestion. Most deaths are caused by intractable seizures, so this complication should be anticipated.

- 158.2.** Which toxidrome is seen after Jimson weed use?
- Anticholinergic
  - Cholinergic
  - Opioid
  - Sedative/hypnotic
  - Sympathomimetic

**Answer: A.** Jimson weed contains atropine, hyoscyamine, and scopolamine, all of which have anticholinergic properties. In severe cases, physostigmine can be used to reverse effects.

- 158.3.** Oleander contains cardiac glycosides similar to digoxin. Which of the following should be considered when treating oleander ingestion?
- Activated charcoal should be avoided.
  - Serum digoxin levels correlate with degree of toxicity.
  - Treatment is supportive.
  - Treatment with digoxin-specific Fab fragments is beneficial, but a higher dose is necessary.
  - Treatment with digoxin-specific Fab fragments is not beneficial.

**Answer: D.** Treatment is with digoxin-specific Fab fragments, but much higher doses are necessary compared with those needed to treat digoxin toxicity. Activated charcoal *may be* useful if the ingestion was recent. A serum digoxin level should be measured, but it is not a reliable indicator of level of toxicity. An elevated level confirms oleander ingestion, but a negative level cannot rule out ingestion.

- 158.4.** A husband and wife present to the emergency department (ED) complaining of nausea and vomiting after eating mushrooms that they picked while hiking. They report eating the mushrooms on a salad approximately 1 hour ago. Each is complaining of severe nausea, vomiting, and diffuse abdominal pain. There is no hematemesis. Vital signs and physical examination are normal. You inform them that they will be symptomatically treated and observed, but there is likely nothing to worry about. Why are you not concerned about their ingestion?
- Early onset of gastrointestinal (GI) symptoms
  - No hematemesis
  - No right upper quadrant tenderness
  - Normal mental status
  - Normal vital signs

**Answer: A.** The vast majority of severely toxic mushrooms have delayed onset of symptoms (>6 hours from ingestion). Occasionally, people will ingest two different types of mushrooms—one benign and causing early onset of symptoms and one more toxic. Therefore patients should be observed and rechecked.

- 158.5.** What is the most common cause of death after mushroom ingestion?
- Gastrointestinal (GI) hemorrhage
  - Heart failure
  - Liver failure
  - Renal failure
  - Respiratory failure

**Answer: C.** The *Amanita* species of mushrooms are very toxic and cause fulminant liver failure often necessitating liver transplant. Mushrooms generally do not affect the other listed organ systems.

- 158.6.** A 46-year-old man presents after waking in the night with headache and severe nausea and vomiting. For dinner the night before, he consumed some mushrooms that he had gathered from a nearby forest. He felt fine immediately after dinner. His vital signs are normal. While conducting your physical examination, he begins to seize. Benzodiazepines are administered without improvement. What treatment is indicated?
- Phenobarbital
  - Phenytoin
  - Propofol
  - Pyridoxine
  - Vecuronium

**Answer: D.** Most mushrooms do not cause seizures, but gyromitrin-containing mushrooms are an exception. They are commonly mistaken for edible morels, because they look quite similar. They contain an isoniazid (INH)-like toxin that causes seizures. Traditional seizure medications can be used (because they are typically more readily available), but seizures can be intractable until pyridoxine is given.

## KEY CONCEPTS

- Barbiturate intoxication is rare, and most patients recover with observation and supportive care alone. Hemodialysis is not indicated unless the patient remains hemodynamically unstable despite adequate supportive measures.
- A urine toxicology screen positive for barbiturates does not prove that the drug caused the patient's clinical condition. Serum barbiturate levels confirm the diagnosis, but do not correlate well with depth of coma or clinical outcome.
- Flumazenil is not indicated in the majority of benzodiazepine overdoses, particularly not in regular benzodiazepine users, in whom flumazenil can precipitate seizures. Because flumazenil's duration of action (about 1 hour) is much shorter than that of all commonly available benzodiazepines, if flumazenil is used patients should be monitored closely for recurrent respiratory depression or re-sedation.
- Chloral hydrate toxicity may result in sedation and cardiotoxicity, principally in the form of supraventricular tachycardias, which are best treated with a beta blocker.
- Endotracheal intubation to protect against emesis, aspiration pneumonia, and hypoxia is often necessary for patients with significant CNS or respiratory depression from GHB overdose.
- Withdrawal from GHB or its precursors begins with anxiety, tremor, and insomnia, but it can progress to a severe syndrome characterized by delirium and autonomic instability. Management of this syndrome often requires high-dose benzodiazepine or barbiturate therapy.

## CHAPTER 159: QUESTIONS &amp; ANSWERS

- 159.1.** How do barbiturates affect peripheral and cerebral blood flow?
- Decrease peripheral pressure and have no effect on intracranial pressure
  - Decrease peripheral pressure and increase intracranial pressure
  - Decrease peripheral and intracranial pressure
  - Increase peripheral and intracranial pressure
  - Increase peripheral pressure and decrease intracranial pressure

**Answer: C.** Barbiturates cause direct cardiac depression with decreased cardiac output. In addition, they cause venous pooling and blunt the normal compensatory increase in system vascular resistance that would occur with decreased cardiac output. They also decrease cerebral blood flow and lower intracranial pressure. These effects are particularly pronounced in individuals with an already low cardiac output, such as in congestive heart failure or hypovolemic shock.

- 159.2.** Other than general supportive care, which of the following is most useful in the management of a severe phenobarbital overdose with hemodynamic instability?
- Flumazenil
  - Hemodialysis
  - Multidose activated charcoal
  - Urinary alkalinization
  - Whole bowel irrigation

**Answer: B.** Although rarely indicated, hemodialysis is effective for acute phenobarbital toxicity (serum levels over 100 mcg/mL) in the presence of refractory hypotension, renal or cardiac failure, acid-base or electrolyte abnormalities, or inadequate response to less invasive measures (as assessed by declining serum levels). These patients often require mechanical ventilation, so the patient's airway should be secured prior. Although there is evidence that multi-dose activated charcoal (MDAC) increases clearance of phenobarbital and may shorten duration of clinical toxicity, there is no evidence it results in improved outcomes over supportive care alone. Flumazenil will reverse the effect of benzodiazepines but has no effect on barbiturates. Urinary alkalinization has traditionally been used to "trap" the acidic barbiturates in the urine to increase excretion. However, a recent comprehensive review concluded that there is little clinical role for urine alkalinization in acute barbiturate poisoning. Whole bowel irrigation is not beneficial.

- 159.3.** All of the following patients have depressed mental status, decreased respiratory drive, and mild hypotension. Supportive care has been initiated. All of the patients have a confirmed benzodiazepine overdose by a reliable historian. For which patient is it most reasonable to consider the use of flumazenil?
- A 5-year-old boy with no known medical problems who took his mother's medication
  - A 22-year-old woman with no known medical problems
  - A 30-year-old man who is known to abuse cocaine
  - A 43-year-old man with depression and anxiety
  - A 79-year-old woman with congestive heart failure, coronary artery disease, and diabetes who takes benzodiazepines for insomnia

**Answer: A.** Flumazenil variably reverses the effects of benzodiazepines but can cause dysrhythmias and intractable seizures. Contraindications for flumazenil include history or suspected chronic benzodiazepine use (which are the vast majority of benzodiazepine overdose patients), co-ingestants that lower the seizure threshold, tricyclic antidepressants, cocaine, history of seizure disorder, chronic alcoholism, and head trauma. Its use should be for a known non-habituated patient (eg, the pediatric patient described here). Because flumazenil's duration of action is short compared with the benzodiazepine and it has variability to reverse respiratory depression, patients require close, monitored observation, repeated dosing or continuous infusion, and preparations to manage the airway. Because benzodiazepine overdose is rarely lethal and patients recover with supportive care, using an antidote requires a careful benefit/risk analysis.

- 159.4.** Which of the following sedative hypnotics is most likely to cause fatal cardiac dysrhythmias in overdose?
- Buspirone
  - Chloral hydrate
  - Eszopiclone
  - Flunitrazepam
  - Zolpidem

**Answer: B.** Chloral hydrate sensitizes the myocardium to catecholamines and also independently induces dysrhythmias. Treatment of choice of dysrhythmias from chloral hydrate is beta-blockers. None of the other listed medications cause significant cardiac toxicity.



**159.5.** A 53-year-old woman presents with decreased mental status and mild hypotension. She is arousable to pain. Her husband reports that approximately 4 hours ago she had been complaining of insomnia and said she was going to take something to help her sleep. He then found her in her present state with an empty bottle of “sleeping pills” on the counter. He does not remember the name of the sleeping pills. Supportive care is initiated. Which of the following laboratory tests would be the most helpful to manage this patient?

- A. Acetaminophen level
- B. Arterial blood gas
- C. Serum chemistry
- D. Serum myoglobin
- E. Urine drug screen

**Answer: A.** Many over-the-counter (OTC) sleep aids contain acetaminophen or salicylates. The active ingredient in OTC sleep aids is an antihistamine, typically diphenhydramine or doxylamine. Both have anticholinergic effects in addition to causing sedation. Toxicity is typically mild and can be successfully managed with supportive care. It is rare that an antihistamine overdose results in rhabdomyolysis, and a serum creatine phosphokinase level, urinalysis, and urinary myoglobin level can be checked if there is concern. Myoglobin is cleared rapidly from the serum and is not a useful diagnostic test. Arterial blood gases, serum chemistries, and urine drug screens can be ordered if there is a complicated clinical course—but only rarely alter treatment.

**159.6.** A 21-year-old woman is brought to the emergency department (ED) by her friends after they found her unconscious in the bathroom of a local bar. The friends report that she had only had one or two alcoholic drinks. The patient’s vital signs show mild bradycardia, hypotension, and bradypnea. Physical examination reveals miosis and short periods of apnea. She awakens briefly to noxious stimuli. You suspect that she may be suffering from gamma-hydroxybutyrate (GHB) poisoning. What is the most appropriate next step in management?

- A. Atropine
- B. Electrocardiogram
- C. Endotracheal intubation
- D. Flumazenil
- E. Naloxone

**Answer: C.** GHB frequently causes emesis and aspiration because patients are unable to protect their airways. Patients with significant GHB overdose should be intubated, but supportive care alone is all that is required for most GHB overdoses. The half-life is short, and many patients will return to baseline mental status in several hours. Bradycardia is common, usually mild, and does not typically require atropine, but this can be used if bradycardia is severe. GHB does not cause dysrhythmias. Neither flumazenil nor naloxone has any effect on GHB.

**159.7.** A 30-year-old man presents with anxiety and insomnia. He is agitated and has a tremor on physical examination. His vital signs are as follows: blood pressure, 200/124 mm Hg; heart rate, 123 beats/min; respiratory rate, 22 breaths per minute; and temperature, 37.5° C. On further questioning, he reports that he chronically uses gamma-hydroxybutyrate (GHB) for muscle building but has not been able to take any for approximately 24 hours. Lorazepam is given in two escalating doses without response. Which of the following should be given next?

- A. A barbiturate
- B. Additional lorazepam
- C. Clonidine
- D. GHB
- E. Labetalol

**Answer: A.** GHB withdrawal is severe, and deaths have been reported. GHB acts as a central nervous system (CNS) depressant, so withdrawal causes CNS excitement and autonomic instability. Chronic GHB abuse can lead to GABA depletion in the CNS. Because benzodiazepines require the presence of GABA, they may not be effective. Barbiturates act independently of GABA and are therefore more effective in GHB withdrawal. Clonidine can be used in opioid withdrawal but is not useful in GHB withdrawal. Labetalol would improve the vital signs but would have no effect on the underlying cause of the autonomic instability.

## KEY CONCEPTS

- Patterns of illness and injury vary by age, and a number of anatomic and physiologic characteristics affect the presentation and management of pediatric emergencies.
- A basic understanding of normal development will aid the emergency clinician in assessment of the pediatric patient.
- The pediatric assessment triangle (PAT) can be used as a tool for rapid evaluation of the patient's overall status.
- Tachypnea in children must be evaluated relative to age norms and is often a sign of increased metabolic demands. A child with tachypnea despite normothermia should be evaluated for respiratory and nonrespiratory causes (eg, hypoperfusion, acidemia).
- Maintenance of a neutral thermal environment is necessary for critically ill infants.
- Child abuse should be considered when injuries are inconsistent with history, when details of the history change, or with certain injury patterns.
- A joint guideline of the American College of Emergency Physicians, American Academy of Pediatrics, and Emergency Nurses Association summarizes the role of pediatric emergency care coordinators, development of pediatric policies, and recommended equipment, supplies, and medications for EDs.
- The family's presence should be encouraged for pediatric procedures and resuscitations.
- A variety of pharmacologic and nonpharmacologic techniques are available to decrease procedural pain and anxiety.

## CHAPTER 160: QUESTIONS &amp; ANSWERS

- 160.1.** Which of the following respiratory signs is characteristic of a child in compensated or decompensated shock?
- Grunting with abnormal breath sounds
  - Tachypnea with nasal flaring
  - Tachypnea without aberrant breath sounds on auscultation
  - Tripoding with stridor
  - Wheezing with retractions

**Answer: B.** Effortless tachypnea, or rapid respirations with clear breath sounds, is characteristic of a child in compensated or decompensated shock. Grunting, nasal flaring, tripoding, stridor, wheezing, and retractions are all signs of increased work of breathing and would be more indicative of pulmonary or airway disease.

- 160.2.** As the pediatric physician coordinator for your emergency department, you decide to institute new policies to prevent pediatric medication errors. Which of the following strategies will be most effective in decreasing risk of dosing errors?
- Pharmacy review of medication orders
  - Use of length-based resuscitation tapes
  - Use of resuscitation calculators
  - Weighing and recording the weight in kilograms

**Answer: D.** Weights should be measured and recorded in kilograms, not pounds, to avoid inadvertent dosing calculations using pounds instead of kilograms. The use of length-based resuscitation tapes and resuscitation calculators and pharmacy review of medication orders have also been suggested to reduce medication dosing errors, but the most effective measure is to weigh and record the weight in kilograms.

- 160.3.** You have written an order for a blood draw and placement of an intravenous line in a nervous 3-year-old boy. Which of the following is least likely to be helpful in decreasing the patient's procedure-related distress?
- Application of a lidocaine-epinephrine-tetracaine mixture
  - Having the patient blow bubbles prior to the needle stick
  - Needle-free jet injection of local anesthetic
  - Use of a vapocoolant

**Answer: A.** The formulation of lidocaine-epinephrine-tetracaine only works on broken skin (ie, lacerations). Unlike eutectic mixture of local anesthetic (EMLA) and 4% liposomal lidocaine preparations which are effective on intact skin, it will not work on intact skin. The use of vapocoolants and a needle-free jet injection of local anesthetic may decrease the patient's pain. Distraction techniques such as blowing bubbles, singing a song, or watching a video may relieve procedure-related anxiety.

## KEY CONCEPTS

- Pediatric airway management is a relatively rare skill to perform in most emergency departments (EDs), and skill maintenance is difficult based solely on clinical practice.
- There are several anatomic differences that impact pediatric airway management, and these occur mostly in the very young child (<2 years old). Small infants have a large occiput and a high, anterior airway, which impacts positioning during intubation. They have a small, underdeveloped cricothyroid membrane, making needle cricothyrotomy the procedure of choice for surgical rescue of the failed airway. They are also more dependent on diaphragmatic excursion for ventilation, thus gastric insufflation can result in difficulty with providing rescue ventilation.
- Children are prone to desaturation due to their high metabolic rate and small functional residual capacity, making preoxygenation and maintenance of oxygenation during intubation crucial.
- The cognitive burden inherent in dealing with the large age/size spectrum in pediatrics can be overcome with reference aids that organize equipment selection and drug dosing based on length/age/size. Formulas have been developed to aid in selection of the correct endotracheal tube (ETT) size and determine appropriate depth of ETT insertion. For estimation of uncuffed tube sizes in children older than 1 year old:  $\text{ETT size} = 4 + (\text{age in years}/4)$ . Subtract 0.5 in size for cuffed tubes. To estimate the depth of ETT insertion (the so-called "lip to tip" distance), multiply the ETT size  $\times 3$  (eg, a 5.0 ETT would be inserted to 15 cm at the lip).
- Rapid sequence intubation (RSI) is the preferred method of airway management in the vast majority of pediatric cases in the ED.
- Compared to adults, children are more prone to desaturation over the time it takes for a neuromuscular blocking agent (NMBA) to take effect. Use of high-flow nasal cannula during the apneic period of RSI has not been well studied in children, but we recommend its use at 5 L/min for infants and 15 L/min for children and adolescents. Assisted ventilation (coordinated with the child's respiratory efforts) should only be used if oxygen saturation drops below 95%.
- Video laryngoscopy is an evolving technology for use in pediatrics and assists in visualization of the airway but prolongs time to intubation.
- Surgical airway techniques differ in infants and young children, necessitating a needle technique that is different from the older child or adult. This technique provides a mechanism to oxygenate the "can't intubate, can't ventilate" child, but should not be relied on as a definitive airway.

## CHAPTER 161: QUESTIONS &amp; ANSWERS

161.1. Which of the following is a correct formula?

- A. Cuffed ETT size (1 to 10 years old) =  $4 + (\text{age in years}/2)$
- B. ETT depth =  $3 \times \text{ETT size}$
- C. ETT depth =  $4 \times \text{ETT size}$
- D. Uncuffed ETT size (1 to 10 years old) =  $(16/\text{age in years}) + 4$

**Answer: B.** Correct formulas are as follows:

Uncuffed ETT size =  $4 + (\text{age in years}/4)$   
 Uncuffed ETT size =  $3.5 + (\text{age in years}/4)$  (or subtract 0.5 from the formula for uncuffed tubes)  
 ETT depth =  $3 \times \text{uncuffed tube size}$

161.2. Which of the following should be used for proper positioning of the pediatric patient during endotracheal intubation?

- A. The chin should be tilted and the head lifted.
- B. The infant younger than 6 months old should have a towel roll placed under his occiput to align the airway axes.
- C. The neck should be placed in slight flexion and the shoulders extended.
- D. The patient should be positioned so that a line drawn through the external auditory canal and the anterior shoulder is parallel to the bed.

**Answer: D.** The relatively large head and occiput of the infant results in slight flexion at the neck when supine, impeding the ability to visualize the glottis. The infant is correctly positioned so that a line drawn through the external auditory canal and the anterior shoulder is horizontal and parallel to the bed. In the infant (<6 months old), this is accomplished by placing a towel roll under the patient's shoulders, elevating the body and overcoming the flexion associated with their large occiput. A head tilt-chin lift may open the airway.

161.3. Relative to rapid sequence intubation (RSI) in adults, children undergoing RSI:

- A. Are less affected by stomach pressures
- B. Are more likely to develop bradycardia in response to hypoxia
- C. Have less missed intubations
- D. Have less pliable airways
- E. Maintain their oxygen saturations longer after paralytics are administered

**Answer: B.** Children have a higher metabolic rate and thus a higher oxygen demand. In the absence of respiratory support, children will drop their oxygen saturations more quickly than adults due to their relatively greater consumption of oxygen. The more pliable pediatric thorax combined with children's lower ventilatory reserve make stomach inflation a significant impediment to effective respiratory support. Pediatric intubations are infrequent and multiple pediatric intubation attempts are more common in children than in adults.

161.4. Which of the following does *not* characterize the pediatric airway relative to adults?

- A. A straight blade is used to pick up the floppy epiglottis.
- B. Infants may require a shoulder roll to align airway axes.
- C. The airway is more pliable.
- D. The airway is more superior and posterior.
- E. The epiglottis is larger and omega-shaped.

**Answer: D.** Small infants have a large occiput and a high, anterior airway, which impacts positioning during intubation, often requiring a shoulder roll to align airway axes. The airway is also more pliable and the membranes thinner, necessitating needle cricothyroidotomy for surgical airways in children younger than 10 years old. Blade choice is age-dependent, and a straight blade is recommended in young children; this blade lifts the relatively large epiglottis to visualize the vocal cords.

161.5. Following the administration of succinylcholine in a 7-year-old boy with respiratory distress, severe masseter spasm is noted. Which of the following medications should be administered to terminate this spasm?

- A. Diazepam
- B. Fentanyl
- C. Repeated dose of succinylcholine
- D. Rocuronium
- E. Thiopental

**Answer: D.** Masseter muscle spasm is a rare side effect of succinylcholine administration. It primarily occurs in pediatric patients and is typically terminated by the administration of a competitive neuromuscular blocking agent (NMBA), such as rocuronium, vecuronium, or pancuronium. Failure to respond to such therapy should prompt consideration of malignant hyperthermia.

## KEY CONCEPTS

- Patients of all ages experience pain, even infants, neonates, and premature babies.
- Oligoanesthesia, the inadequate treatment of pain, has many short-term and long-term consequences: worse patient outcomes, increase in patient's pain threshold, and development of chronic pain.
- Pain management may include a combination of techniques: analgesics, topical anesthetics, local anesthetic injections, and nonpharmacologic interventions.
- Nonpharmacologic interventions to decrease pain or anxiety include oral sucrose in infants; parental presence; physical measures, such as heat or cold therapy and splinting for musculoskeletal injuries; and behavioral or cognitive measures, such as distraction and play therapy.
- Topical anesthetics are recommended to decrease the pain of minor procedures, such as venipuncture or IV cannulation.
- Techniques for decreasing the pain of intradermal injections include topical agent prior to the intradermal injection; slowly injecting warmed, buffered local anesthetic solution from within the wound with the smallest gauge needle possible; and limiting the number of needle punctures.
- When using large amounts of local anesthetics in small children or infants, calculate the drug dose to avoid toxicity; a 1% solution = 1 g/100 mL or 10 mg/mL.
- Procedural sedation and analgesia (PSA) requires pre-sedation evaluation; sufficient monitoring (during and after the procedure) by qualified individuals capable of dealing with any adverse events that may occur; age-appropriate equipment (including airway equipment) and medications (including reversal agents and advance life support drugs); and discharge criteria for when the patient is fully awake, returns to baseline with stable vital signs, and is able to be discharged in the care of a responsible adult.
- Overall, preprocedural fasting is not necessary for most emergency patients, because large studies show no clinically significant differences with airway complications, emesis, or other adverse effects between groups of patients stratified by their preprocedural fasting status.
- Choice of sedative and analgesic for PSA depends on many variables including patient factors and the procedure to be done. Slow titration of medications can achieve the desired level of sedation and analgesia while minimizing risk of adverse events.

## CHAPTER 162: QUESTIONS &amp; ANSWERS

- 162.1.** When do most adverse events associated with emergency department (ED) procedural sedation occur?
- A. During the manipulation or intervention
  - B. 5 to 20 minutes after the last sedative dose
  - C. 20 to 30 minutes after the last sedative dose
  - D. 30 to 60 minutes after the last sedative dose
  - E. 60 to 90 minutes after the last sedative dose

**Answer: B.** High-risk times are 5 to 20 minutes after the last medication administration and at the completion of the procedure when there is no longer a painful stimulus but the patient remains sedated.

- 162.2.** Which of the following modalities has proven most effective for monitoring patients undergoing procedural sedation?
- A. Capnometry or capnography
  - B. Cardiac rhythm monitoring
  - C. Continual direct visual observation of qualitative clinical signs
  - D. Documented respiratory rate
  - E. Pulse oximetry

**Answer: C.** The patient's ability to follow commands in response to varied levels of stimulation and direct observation of the ventilatory status have been the most reliably documented methods of assessing the level of consciousness during procedural sedation. Pulse oximetry is a reliable adjunct, but it identifies hypoventilation late, especially when used with supplemental oxygen. Cardiac monitoring has been shown to be helpful in older patients or in those with a history of cardiac disease, but there is no evidence that it is of any benefit in young healthy patients. End-tidal carbon dioxide monitoring has been shown to be useful to detect inadequate ventilation earlier than oximetry, especially when direct observation of the patient is difficult, but no studies have demonstrated an effect on clinical outcome to date. Recently, the American Society of Anesthesiologists (ASA) updated its procedural sedation standards to include capnography during moderate or deep sedation, in addition to the continual observation of qualitative clinical signs. Respiratory rate alone is an insensitive indicator of adequacy of ventilation.

- 162.3.** Which of the following agents is matched with the correct associated side effect?
- A. Etomidate—limited (30-minute) duration of sedation
  - B. Ketamine—laryngospasm
  - C. Methohexital—venoirritation
  - D. Pentobarbital—seizures
  - E. Propofol—myoclonus

**Answer: B.** Ketamine has been associated with laryngospasm in children younger than 3 months old and those with a respiratory infection. The following are the other correct associations:

- Etomidate—myoclonus
- Methohexital—seizures
- Pentobarbital—30-minute duration
- Propofol—venoirritation

- 162.4.** Which of the following statements regarding the use of ketamine is false?
- A. Benzodiazepine coadministration has not been shown to reduce the incidence of emergence phenomenon in children.
  - B. Despite increased secretions, airway reflexes are generally well maintained.
  - C. Hypotension is common.
  - D. Profound analgesic and sedative effects occur with minimal respiratory depression.
  - E. Repeat doses are well tolerated in longer procedures.

**Answer: C.** Ketamine increases the release of catecholamines upon administration and supports blood pressure well. It also decreases smooth muscle tone in the bronchial tree and may have a benefit in patients with reactive airways disease. Several studies have failed to show benefit with the concurrent administration of low-to-moderate dosages of benzodiazepines in preventing emergence phenomenon in children. These studies have shown a slightly increased risk of side effects. Their routine use is discouraged and should be reserved for the actual treatment of severe emergence phenomenon.

- 162.5. Which of the following statements regarding the use of propofol is true?
- A. Propofol has a long duration of action and provides significant analgesia.
  - B. Propofol has significant antiemetic properties.
  - C. Propofol is cerebroprotective.
  - D. Propofol is well tolerated in volume-depleted patients.
  - E. The use of “ketofol” (ketamine in combination with propofol) is clinically superior to the use of propofol alone.

**Answer: B.** Propofol is an ultra–short-acting, sedative-hypnotic, cerebroprotective agent with no analgesic but profound antiemetic properties. Its adverse effects include dose-dependent respiratory depression, apnea, hypotension, and pain on injection. Preload-dependent patients are particularly susceptible to hypotension. Its combined use with ketamine is common. The two agents are felt to have synergistic effects that balance each other’s deficits. The combined use has been shown to improve provider satisfaction, sedation quality, and decrease emesis but has not been shown to be clinically superior to either agent used alone regarding respiratory depression, airway complications, or improved recovery times.

- 162.6. Which of the following statements is true regarding the need for fasting before procedural sedation?
- A. A 6-hour period of fasting is required after the ingestion of liquids or solids before procedural sedation.
  - B. Preprocedural fasting is required in all circumstances.

- C. The recommendation for preprocedural fasting is based on controlled trials involving patients undergoing procedural sedation.
- D. The risk of vomiting and the loss of the airway protective reflexes is an extremely rare occurrence during procedural sedation.
- E. There is an increased risk of aspiration during procedural sedation after a liquid or solid meal.

**Answer: D.** The American Society of Anesthesiologists (ASA) currently recommends a period of 2 hours after ingestion of clear liquids, a period of 4 hours after ingestion of breast milk, and a period of 6 hours after ingestion of other liquids or solids before the performance of procedural sedation. This recommendation is based on expert consensus and extrapolated from data on patients receiving general anesthesia and manipulation of the airway during intubation and extubation. There are no published studies showing increased risk of aspiration after a liquid or solid meal, nor benefits of fasting before procedural sedation. There are large studies showing no clinically significant differences with airway complications, emesis, or other adverse effects between groups of patients stratified by their preprocedural fasting status. Adherence to the ASA preoperative fasting guidelines for procedures is not necessary in emergency department (ED) patients undergoing procedural sedation and analgesia (PSA).



## KEY CONCEPTS

- Exact rates, depths, and ratios of compressions to ventilations in cardiopulmonary resuscitation (CPR) are not based on high quality evidence. It is most important to push fast, deep, and without interruptions. We recommend a depth of  $1\frac{1}{2}$  inches in infants and 2 inches in older children.
- Unlike in adults, conventional CPR versus compression-only CPR is recommended in most children, because children often arrest from respiratory causes. This is less important for the emergency department (ED) setting where compressions and ventilations should begin almost simultaneously.
- In pediatric arrest, timely acquisition of vascular access is much more important than the site of access; when access is needed, the intraosseous route is recommended.
- Central venous access is not required emergently in most pediatric arrests.
- The focus in pediatric cardiac arrest should be on providing high quality, uninterrupted compressions and ventilations, not medication administration.
- If defibrillation is indicated, begin at 2 J/kg, followed by 4 J/kg, and if needed increase to 10 J/kg for subsequent shocks.
- Compared to adults, septic children more commonly display cold shock with hypovolemia and peripheral vasoconstriction.
- Most children with an acute life-threatening event (ALTE) do not require any diagnostic tests.
- Unless specifically indicated, do not administer calcium or sodium bicarbonate in pediatric arrest of unknown cause.
- After return of circulation, focus on avoiding hypotension (intravenous [IV] fluids and vasoactive medications) and hyperthermia (antipyretics and cooling blankets).
- When death is likely, family presence at pediatric resuscitations provides significant lasting benefits for the family.
- There are no universal criteria to terminate resuscitation efforts in children. We recommend considering the termination of resuscitation after 30 minutes for unwitnessed out of hospital pediatric cardiac arrest.
- Due to the inherent risks associated with pediatric intubation, providers who lack extensive experience caring for critically ill children should focus on bag-mask ventilation, particularly for children in cardiac arrest or infants younger than 1 year old.
- Signs of sepsis overlap with the signs of many non-critical febrile illnesses in children.
- Treatment of pediatric sepsis in the United States should include rapid fluid boluses (total of 40 to 60 mL/kg for hypotension), broad-spectrum antibiotics, early use of vasopressors for signs of poor perfusion, and close monitoring.
- Otherwise healthy children with a first ALTE occurring while feeding/choking, normal examination, prompt follow-up, and no high-risk features are candidates for discharge after a period of observation in the ED.

## CHAPTER 163: QUESTIONS &amp; ANSWERS

**163.1.** A 3-year-old girl presents to the emergency department (ED) with fever, lethargy, and a petechial rash. Her initial vital signs are: heart rate, 186 bpm; respiratory rate, 60 breaths per minute; blood pressure, 62/21 mm Hg; and pulse oximetry, 92% on room air. She is listless and ill appearing, with pale, cool extremities, and a capillary refill time of 4 to 5 seconds. After application of 100% oxygen and obtaining vascular access, what treatment should the patient receive next?

- Calcium gluconate 50 to 100 mg/kg by intravenous push (IVP)
- Ceftriaxone 100 mg/kg by rapid IVP
- Dopamine at 5 to 10 mcg/kg/minute continuous infusion
- Glucose 0.5 g/kg by rapid IVP
- Normal saline 20 cc/kg by rapid IVP

**Answer: E.** Septic shock in children presents most commonly as a physiologic state of hypovolemia and increased systemic vascular resistance. Immediate and rapid isotonic crystalloid administration is the initial step for all children in shock.

- 163.2.** All of the following are correct features of cardiopulmonary resuscitation (CPR) in children in cardiac arrest *except*:
- Complete release of chest wall between chest compressions
  - Compression:ventilation rate of 15:2 once airway is secured with an endotracheal tube (ETT)
  - Depth of at least one-third the anteroposterior chest diameter
  - Rate of at least 100 compressions/minute
  - Use of a backboard under patient

**Answer: B.** In the intubated patient, compressions should be administered continually at a rate of at least 100/minute and ventilations continuously at a rate of 8 to 10 breaths/minute.

**163.3.** Which of the following statements best describes the practice of family presence in the emergency department (ED) for children?

- Is not recommended; family presence sets up a medical legal minefield for the emergency clinician.
- Is not recommended; providers perceive more stress, leading to clinical errors and family confusion.
- Is recommended; although providers have been shown to perceive more stress when parents are present, clinical care variables have not been shown to be impacted and families are more likely to effectively work through their grieving process.
- Is recommended; providers do not perceive their presence, the grieving process is promoted, and clinical care variables are improved.

**Answer: C.** The American College of Emergency Physicians (ACEP) and American Academy of Pediatrics (AAP) recommend that family be given the option of being present during their child's resuscitation. Families report their presence comforts their children, helps them appreciate the efforts of providers, facilitates their understanding of the gravity of the situation, and promotes the grieving process. Physicians reported increased stress from family presence, but no differences were detected in clinical care variables.

## KEY CONCEPTS

- Resuscitation should be anticipated for all neonates born outside the delivery room; 10% of newborns will require some resuscitation, and 1% will require advanced life support interventions after birth.
- Predictable indications for resuscitation include hypoxia, hypothermia, hypoglycemia, hypovolemia, prematurity, maternal infection, and adverse effects of maternal medication.
- Drying, warming, positioning, and stimulating the infant are sufficient resuscitative measures for most deliveries.
- Adequate ventilation will reverse most bradycardia whereas, in general, 100% oxygen is not indicated for most neonatal resuscitations.
- The NRP resuscitation algorithm provides a proven guide for management and its implementation has shown to improve short- and long-term outcomes, including neurodevelopment.
- Routine tracheal suctioning of vigorous and nonvigorous infants born through meconium-stained amniotic fluid is no longer recommended.
- Weight-based epinephrine and volume expanders are rarely required.
- Significant hypovolemia is rare in neonates. Hemorrhage is one of the few predictable situations in which volume expansion improves newborn outcome.
- Preterm infants and those born to mothers with suspected infection, including chorioamnionitis, should receive empirical antibiotic therapy. An acceptable regimen includes dual therapy with ampicillin and gentamicin.
- Any neonate with persistent cyanosis or signs of respiratory distress (eg, grunting, nasal flaring, tachypnea) should be assisted by CPAP or PPV. Endotracheal intubation should be performed in several situations, such as when bag-mask ventilation is ineffective or prolonged, chest compressions are performed, an extremely low-birth-weight infant is born, and tracheal suctioning for meconium in infants results in failure to improve, despite effective PPV.
- Chest compressions are rarely required because bradycardia generally responds to effective ventilation. However, compressions should be started for an HR less than 60 beats/min, despite oxygen and adequate ventilation for 30 seconds.
- The umbilical vein is the preferred route of immediate vascular access, followed by peripheral veins, peripherally inserted central catheter lines, and the femoral vein. IO line placement can be problematic in neonates.
- No reliable and widely adopted set of parameters has been identified for newborns who should not receive resuscitative efforts. Unless there is clear family, parent, and/or health care provider agreement, all resuscitation efforts should continue until further prognostication can occur.
- Infants receiving appropriate resuscitation efforts nonetheless showing no signs of life after 10 minutes may have further efforts withheld, particularly when this decision is in accord with parental preference.
- All newborns requiring IV placement, medication administration, chest compressions or endotracheal intubation should be transferred to an appropriate neonatal intensive care unit.

## CHAPTER 164: QUESTIONS &amp; ANSWERS

**164.1.** With most neonatal deliveries, which resuscitative measures are usually sufficient?

- A. Administer fluids.
- B. Administer glucose.
- C. Bag-mask ventilate.
- D. Intubate.
- E. Warm, dry, stimulate, and position.

**Answer: E.** Drying, warming, positioning, and stimulating the infant are usually sufficient resuscitative measures in most deliveries.

**164.2.** For a newborn with cyanosis, respiratory distress and a heart rate more than 100 beats/min, which of the following is not initially indicated?

- A. Apply 100% oxygen.
- B. Position airway.
- C. Suction.
- D. Ventilate with bag-mask with room air.
- E. Warm, dry, and stimulate.

**Answer: A.** 100% oxygen is no longer indicated for initial resuscitation; avoiding unnecessary supplemental oxygen is thought to minimize free radical creation in the brain and decreases the incidence of retinopathy of prematurity. Initial resuscitation with room air is recommended.

**164.3.** In a typical neonatal resuscitation, what is the preferred compression-to-ventilation ratio?

- A. 3:1
- B. 5:1
- C. 10:2
- D. 15:2
- E. 30:2

**Answer: A.** Unlike pediatric or adult cardiopulmonary resuscitation (CPR), neonatal CPR is performed at a ratio of three compressions to one breath, with a goal of approximately 90 compressions with 30 synchronized breaths (120 “events”) per

minute. If the cause of the bradycardia is known to be cardiac, a ratio of 15:2 is acceptable.

**164.4.** A nonvigorous and crying newborn is delivered with copious meconium-stained fluid. What is the correct recommended resuscitative measure?

- A. Bag-mask ventilate.
- B. Intubate.
- C. Intubate and suction.
- D. Suction at maternal perineum before cutting umbilical cord.
- E. Gentle mouth suctioning if needed, followed by warming, drying, and stimulation.

**Answer: E.** For infants born with meconium-stained amniotic fluid, routine intubation and endotracheal tube suctioning are no longer recommended because they have shown no consistent benefit. Vigorous and nonvigorous infants born through even thick meconium should instead have gentle mouth suctioning, if needed, followed by warming, drying, and stimulation.

**164.5.** After drying, stimulating, and bag-mask ventilation, what is the next step in resuscitation of a newborn that appears floppy and apneic and with a heart rate of 50 beats/min?

- A. Give a normal saline bolus of 20 mL/kg.
- B. Give epinephrine (1:10,000) intravenous (IV) at a dose of 0.1 mg/kg.
- C. Intubate.
- D. Start with a chest compression-to-ventilation ratio of 3:1.
- E. Suction.

**Answer: D.** With a heart rate less than 60 beats/min in a neonate, intubation may be considered, but compressions should be started. If the low heart rate persists, IV epinephrine (1:10,000) may be considered at a dose of 0.01 mg/kg.

## KEY CONCEPTS

- Trauma is the leading cause of death in children in the United States.
- Avoid hypoxia and hypotension by early administration of oxygen and assisted ventilation, and fluid resuscitation with crystalloid at 20 mL/kg increments. Initiate transfusion of 10 mL/kg of PRBCs if hypotensive or remains with signs of hypovolemic shock after 40 mL of crystalloid is infused.
- Key pediatric anatomic and physiologic differences include:
  - Children are smaller, so force is more widely distributed through the body of a child, making multi-system injuries more likely.
  - The infant's head-to-body ratio is greater, creating a relatively higher center of gravity. This combined with a less myelinated brain and thinner cranial bones may result in more serious head injury.
  - Children have a higher anatomic fulcrum in the cervical spine (C2 to C3 in children <8 years old). This leads to higher C-spine injuries.
  - Children have more lax ligaments of the cervical column. This leads to an increased risk of SCIWORA.
  - Children have more horizontally positioned ribs meaning that with inspiration, the ribs move only up and not out. This leads to a limited ability to increase tidal volume and risk for respiratory failure with chest or diaphragmatic injury.
  - Children have more elastic chest walls that allow for pulmonary injury without skeletal injury.
- Children have thinner abdominal walls and have more anterior livers and spleens. This results in a greater chance of injury to those organs.
- Children have excellent compensatory mechanisms. They can remain normotensive until they lose large amounts of intravascular volume. Hypotension is a very late sign.
- Continuous monitoring and reassessment of the trauma patient is essential to recognize early signs of deterioration and to discover all injuries.
- Most minor head trauma may be managed with observation and without CT imaging. Clinical decision rules when applied may reduce imaging and exposure of children to ionizing radiation.
- In major trauma patients indications for intubation include respiratory failure or a GCS less than 9.
- Most cases of shock in trauma are due to hypovolemia so fluid resuscitation with normal saline is recommended, and the addition of packed cell transfusions should be initiated in a pediatric trauma patient with hypotension or with signs of shock after 40 to 60 mL/kg normal saline.
- The diagnostic test of choice for the evaluation of intra-abdominal injury in a stable patient with high suspicion for injury is CT of the abdomen.
- Splenic injuries are generally treated conservatively in children to ensure immunocompetence.

## CHAPTER 165: QUESTIONS &amp; ANSWERS

- 165.1.** A 5-year-old male is struck by a car while riding a bicycle. On presentation, he exhibits hypotension, a normal heart rate, and quadriplegia. You suspect neurogenic hypotension secondary to spinal shock and attempt to correct the hypotension with fluids but are not successful. Which of the following should be your first choice for a vasopressor?
- Dobutamine
  - Dopamine
  - Epinephrine
  - Phenylephrine

**Answer: D.** Spinal shock is related to decreased systemic vascular resistance (SVR). A pressor with primarily alpha vasoconstrictive effects, such as phenylephrine or norepinephrine, is the best choice for increasing SVR without having other physiologic effects.

- 165.2.** A 6-week-old infant is brought to your emergency department (ED) by his mother after he reportedly fell 3 feet from his changing table approximately 45 minutes ago. His mother reports that the child did not lose consciousness and "seems fine." She is concerned, however, by a large scalp hematoma that developed almost immediately. What is your most important intervention at this point?
- Consulting a social worker to help screen for child abuse
  - Head computed tomography (CT) scan
  - Ice packs for the scalp hematoma
  - Observation in the ED for 4 hours
  - Skull radiographs

**Answer: B.** A 6-week old infant is at high risk for intracranial injury given the softness/deformability of the skull. Scalp hematomas signify possible skull fracture and thus CT of the head is indicated.

- 165.3.** Which of the following is the most commonly injured solid organ in pediatric patients with abdominal trauma?
- Bladder
  - Duodenum
  - Kidney
  - Liver
  - Spleen

**Answer: E.** Injuries to the spleen are the most common injuries in pediatric abdominal trauma. Children involved in motor vehicle collisions (MVCs), sudden deceleration injuries, and contact sports-related injuries may sustain splenic trauma. Treatment includes fluid resuscitation and blood transfusion as needed. Splenic salvage is important for immunocompetence in children and operative intervention is avoided as long as the patient can be stabilized with fluid resuscitation.

- 165.4.** A 4-year-old female is brought to your emergency department (ED) from the scene of an motor vehicle collision (MVC). Paramedics intubated the child in the field because she was unresponsive at the scene. On arrival, her vital signs are within normal limits. Before transport to the computed tomography (CT) scanner, however, you note that she is becoming mildly bradycardic and hypertensive. Her left pupil becomes dilated and nonreactive. Which of the following should be your next immediate action?
- Hyperventilation to a carbon dioxide (CO<sub>2</sub>) level between 30 and 35 mm Hg
  - Mannitol administration
  - Nicardipine infusion
  - Phenytoin administration
  - Proceed immediately to the CT scanner

**Answer: A.** The patient's sudden onset of dilated, nonreactive pupil, along with bradycardia and hypertension, is indicative of acute brain herniation. Immediate hyperventilation to a goal of CO<sub>2</sub> between 30 and 35 mm Hg has been shown to reduce brain injury. CT scanning should not be performed before this potentially lifesaving intervention. The administration of a hyperosmolar agent, such as mannitol or hypertonic saline, is indicated but should not take precedence over hyperventilation. Phenytoin is arguably indicated in this patient but not necessary in the acute setting. Nicardipine and other antihypertensive agents have no place in the management of a head-injured child. Her hypertension is a physiologic response to brain herniation, in which increasing mean arterial pressure (MAP) preserves cerebral perfusion pressure (CPP).

- 165.5.** A 7-year-old girl is brought into the emergency department (ED) by emergency medical service (EMS) personnel from the scene of an motor vehicle collision (MVC). On your primary survey, she is noted to have a clear airway, decreased breath sounds in the right lung field, subcutaneous emphysema, and tracheal deviation to the left. She has thready distal pulses. What is your next step in stabilizing this patient?
- A. Airway control with endotracheal intubation (ETI)
  - B. Bag-mask ventilation (BMV)
  - C. Immediate needle thoracostomy in the second midclavicular space on the right
  - D. Portable chest radiograph to confirm diagnosis

**Answer: C.** This patient is presenting with signs of tension pneumothorax. In this case, immediate decompression with a needle thoracostomy, followed by the placement of an appropriately sized chest tube or immediate chest tube placement is required to avoid cardiovascular collapse.

- 165.6.** Which of the following statements regarding chest injuries in children is correct?
- A. Aortic transection is more likely in a pediatric patient than in an adult patient.
  - B. Multiple rib fractures without significant underlying lung injury are common in children.
  - C. Penetrating chest trauma is more common than blunt chest trauma in pediatric patients.
  - D. Significant pulmonary contusions may be present in the absence of rib fractures in children.

**Answer: D.** The pediatric rib cage has more compliance than an adult rib cage. This makes children predisposed to pulmonary injury in the absence of bony injury. Rib fractures are more rare in the pediatric population because of this, and their presence is concerning for underlying lung injury. Blunt chest trauma is more common than penetrating chest trauma in pediatric patients and concurrent chest and abdominal injuries are common. Aortic transection is more common in adults.

- 165.7.** A 12-year-old male fell while climbing over a 12-foot barbed-wire fence and sustained a deep 10-cm laceration to his medial left thigh. There is active bleeding from the laceration. What is the first step in the management of this patient?
- A. Apply a tourniquet to the leg.
  - B. Begin with a primary survey and assess the patient's airway and breathing.
  - C. Obtain intravenous (IV) access and begin blood transfusion immediately.
  - D. Pack the wound to decrease hemorrhage.

**Answer: B.** The primary survey should quickly assess the airway, breathing, and circulation (ABCs). Initial wound management involves the application of direct pressure to the wound. Approaching trauma patients in a systemic fashion will ensure that large, obvious injuries do not distract from the detection of other injuries. Oftentimes multiple interventions would be done simultaneously. Jaw thrust to open an airway and then another health care providers quickly applying hemorrhage control. The child in the question also fell from a fence and may have other fall-related injuries.

- 165.8.** Which of the following statements regarding imaging of a multi-trauma pediatric patient is correct?
- A. A negative computed tomography (CT) scan of the cervical spine rules out spinal cord injury, and if normal, immobilization can be discontinued.
  - B. A negative focused assessment with sonography in trauma (FAST) examination rules out traumatic intra-abdominal injury, making a CT scan unnecessary.
  - C. In a hemodynamically stable pediatric trauma patient, CT imaging should be complete before transfer to a pediatric trauma facility, even if it delays transfer.
  - D. In a hemodynamically stable pediatric patient with a high level of concern for intra-abdominal trauma, CT scan is the imaging test of choice.

**Answer: D.** CT scan is the diagnostic test of choice for evaluation of intra-abdominal trauma in children. Spinal cord injury without radiologic abnormality (SCIWORA) is more common in pediatric patients, and normal cervical spine CT scan does not rule out spinal trauma. Although often a useful adjunct, a FAST examination does not rule out intra-abdominal injury. In a hemodynamically stable patient, CT imaging does not need to be complete before transfer to a pediatric trauma center and should not delay transfer. With clinical concern for elevated intracranial pressure (ICP), treatment (eg, hyperventilation, mannitol, or hypertonic saline) should be initiated immediately.



## KEY CONCEPTS

- Fever is the most common complaint among pediatric patients presenting to the emergency department (ED), although rates of bacterial illness are lower since the advent of universal vaccination for *Haemophilus influenzae* type b and *Streptococcus pneumoniae*, serious bacterial illness (SBI) must be considered in the undervaccinated or unvaccinated child
- Viruses cause the vast majority of childhood febrile illnesses and are generally self-limited and benign.
- SBI is growth of pathogenic bacteria in a previously sterile site, such as urinary tract infection (UTI), bacteremia, meningitis, osteomyelitis, bacterial gastroenteritis, bacterial pneumonia, cellulitis, or septic arthritis.
- The rate of SBI in infants younger than 3 months old presenting with fever is between 6% to 10%.
- Infants 28 days old and younger are at much higher risk for bacterial illness with fever because of their immature immune systems and incomplete vaccination status, making aggressive evaluation of these children important.
- Empirical treatment of febrile neonates is indicated and appropriate antibiotic regimens include ampicillin plus either gentamicin or cefotaxime, which cover the bacterial organisms likely in this age group.
- Empirical treatment for herpes simplex virus (HSV) should be considered in any neonate with a maternal history of genital herpes, who appears ill, presents with fever and seizure, has cutaneous vesicles on physical examination, or evidence of transaminitis or coagulopathy.
- The most common cause of SBI in children continues to be UTI, and the only reliable method to obtain urine in a non-toilet-trained infant is bladder catheterization or suprapubic aspiration when a catheter sample cannot be obtained.
- Bacterial meningitis can occur at any age but most commonly presents in a relatively small proportion of febrile infants younger than 3 months old (3/1000).
- Respiratory syncytial virus (RSV) and influenza are common viral causes of fever and respiratory distress in infants, although the presence of viral infection does not lower the risk of concomitant SBI in children younger than 28 days old.
- In older infants and children, the documented presence of RSV or influenza significantly reduces the incidence of SBI and can be used to modify the evaluation. Because UTI is still common in this population, a urinalysis should be obtained
- There are several risk-stratification strategies (ie, Boston, Rochester, and Philadelphia criteria) reported in the literature that have similar performance characteristics. All involve a laboratory evaluation designed to identify a subset of febrile infants younger than 3 months old that can safely be managed as outpatients with or without antibiotics.
- Standardization and adoption of a clinical practice guideline for the evaluation of the febrile infant has been shown to reduce variation and cost.
- Due to universal vaccination against pneumococcus, the evaluation of highly febrile children 3 to 36 months old has evolved from one of universal screening for occult bacteremia to one where clinical gestalt determines the need for bloodwork.
- Inflammatory markers, such as C-reactive protein (CRP) and procalcitonin, have been shown to predict bacterial illness in febrile children more accurately than the white blood cell (WBC) count but cannot be relied upon solely to rule-out SBI.
- Traumatic lumbar punctures occur relatively commonly in young infants and can make interpretation of cell counts difficult and use of various formulas to account for the protein and WBCs in the cerebrospinal fluid (CSF) after a traumatic tap should be used with caution.
- The risk of meningitis is exceedingly low in well-appearing children after a simple febrile seizure and lumbar puncture is not recommended.
- Children presenting with fever and petechiae are at risk for infection with meningococcus; blood should be obtained for complete blood count (CBC) and culture and if available CRP or procalcitonin. Children with abnormal CRP or elevated or depressed WBC count, or with bacteremia should be treated with parenteral antibiotics and admitted. Lower risk, well-appearing children with normal laboratory parameters can be considered for close outpatient follow-up.
- Children with fever who also are receiving cytotoxic chemotherapy for cancer are at high risk for bacteremia and sepsis and should receive prompt broad spectrum antibiotic therapy after appropriate diagnostic evaluation (at the minimum, a CBC and blood culture).
- Patients with fever and a history of sickle cell disease are at risk for bacteremia from encapsulated organisms due to functional asplenia and should be considered high risk and should be admitted and treated.

## CHAPTER 166: QUESTIONS &amp; ANSWERS

- 166.1.** Which of the following are appropriate methods to obtain urine as part of a fever evaluation in a non-toilet-trained child?
- A. Catheterized specimen
  - B. Clean catch, midstream
  - C. Suprapubic aspiration
  - D. A and B

**Answer: D.** The only reliable method to obtain urine in a non-toilet-trained child is bladder catheterization or suprapubic aspiration if a catheter specimen cannot otherwise be obtained. Bag collection has a high rate of false-positive results and should not be used in a child who is not toilet trained.

- 166.2.** Which of the following statements regarding occult bacteremia in children younger than 36 months old is true?
- A. Children with no obvious source of fever and a temperature higher than 102.2°F (39°C) have an incidence of bacteremia of 5%.
  - B. Most patients appear toxic.
  - C. The most common pathogen is *Neisseria meningitidis*.
  - D. There has been a marked decrease in the incidence of occult bacteremia since the advent of universal vaccination against pneumococcus and *Haemophilus influenzae* type B.
  - E. With pneumococcal bacteremia, most patients remain febrile until antibiotic therapy is initiated.



**Answer: D.** Children younger than 36 months old with fever higher than 102.2°F (39°C) and no obvious source have an incidence of occult bacteremia of less than 1%. Most patients appear nontoxic. The most common pathogen in positive cultures is *Streptococcus pneumoniae*, and the incidence of infection has dropped dramatically since the advent of universal vaccination. With pneumococcal bacteremia, most patients become afebrile in 3 or 4 days with or without antibiotic therapy.

- 166.3.** A 3-year-old boy presents with fever of 103°F. His mother reports that the fever started approximately 5 days ago, and he has an associated maculopapular rash. On examination, you find the patient also has bilateral conjunctival injection, a strawberry tongue, and swelling of his hands and feet. Which of the following medications should be included in the treatment of this patient?
- A. Aspirin
  - B. Clindamycin
  - C. Decadron
  - D. Penicillin G
  - E. Rocephin

**Answer: A.** This patient has Kawasaki disease. Treatment includes amelioration of symptoms and prevention of coronary aneurysms, which are normally treated with aspirin and immunoglobulin. There are no indications for antibiotics or steroids.

- 166.4.** A 2-year-old presents with a high fever and vomiting. On examination, you find an irritable child with a rectal temperature of 102°F rectal and a stiff neck. The patient's past medical history is significant for hydrocephalus with a ventriculoperitoneal shunt placement. You suspect the patient has a ventriculoperitoneal shunt infection. Which of the following is the most likely bacterial pathogen?
- A. *Haemophilus influenzae*
  - B. *Neisseria meningitidis*
  - C. *Staphylococcus aureus*
  - D. *Staphylococcus epidermidis*
  - E. *Streptococcus pneumoniae*

**Answer: D.** Patients with ventriculoperitoneal shunts and fever must be evaluated for shunt infection. The most common bacterial pathogen is *S. epidermidis*.

## KEY CONCEPTS

Respiratory arrest precedes most pediatric cardiac arrests. Quick recognition of an airway problem and intervention in potentially life-threatening upper airway obstruction in children are critical.

**Retropharyngeal Abscess**

- This is a potentially life-threatening emergency in young children with signs of upper airway obstruction or meningismus; a retropharyngeal abscess is often related to oral trauma.
- Retropharyngeal abscess is most frequently caused by *Staphylococcus aureus*, group A streptococci, and anaerobes. Treatment is admission, IV antibiotics and, for more severe cases, surgical drainage.

**Epiglottitis**

- Epiglottitis may be caused by many bacteria or local injury. In the post-*H. influenzae* type b vaccine era, the typical profile of epiglottitis has changed to include older patients.
- Clinical features of epiglottitis are often subtle, such as in the older adolescent, (eg, sore throat out of proportion to physical findings, anterior neck tenderness), but may also be dramatic, as in infants and young children (ie, drooling, stridor, toxicity, severe respiratory distress).

**Croup**

- Viral croup is the most common infection of the upper airway in young children.
- Glucocorticoids (usually given as a single oral dose of dexamethasone) reduces symptoms, hospitalizations, and length of stay in the ED.

- Treatment of moderate to severe croup includes vaporized epinephrine in addition to glucocorticoids. These patients can be discharged from the ED after a posttreatment observation period of 2 to 3 hours if they remain free of stridor and distress and have access to follow-up care.

**Bacterial Tracheitis**

- Suspect bacterial tracheitis when a URI progresses to acute toxicity and marked respiratory distress and stridor. Standard treatment for croup should be initiated but does not improve the patient's symptoms. Antibiotic therapy should include a cephalosporin plus coverage for *S. aureus*, which is the most common cause of this infection.
- Bronchoscopy is diagnostic and therapeutic and should be emergently performed.

**Airway Foreign Body**

- Complete obstruction due to an airway foreign body requires emergent basic followed by advanced life support procedures for removal of the foreign body.
- Plain films may be negative in aspirated foreign bodies. Bronchoscopy should be performed with a clinical suspicion of aspiration.
- Emergency cricothyroidotomy may be required for obstructed patients who cannot be intubated or ventilated as a lifesaving temporizing measure; needle cricothyroidotomy is preferred for infants and young children because of the challenges in identifying landmarks and associated complications of surgical cricothyrotomy.

## CHAPTER 167: QUESTIONS &amp; ANSWERS

**167.1.** Which of the following is the most common cause of upper respiratory obstruction in childhood?

- Airway foreign body
- Bacterial tracheitis
- Croup
- Epiglottitis
- Retropharyngeal abscess

**Answer: C.** Although all the choices may lead to symptoms of airway obstruction in children, the most common cause of upper airway obstruction is viral croup.

**167.2.** A 3-year-old girl presents at 2 AM with complaints of a barking cough, which started abruptly overnight. Vital signs are heart rate, 140 beats/min, respiratory rate, 40 breaths/min, and temperature, 100.1° F (38°C). She has no history of asthma or wheezing. She appears to be in moderate distress and has audible stridor. Indications for admission include which of the following?

- Low-grade fever
- Prior history of croup
- Pretreatment for tachycardia and tachypnea
- Pretreatment for stridor
- Severe dehydration

**Answer: E.** Indications for admission of patients with croup include severe respiratory distress or failure, unusual symptoms (hypoxia and hyperpyrexia), anything but mild dehydration, persistence of stridor at rest after aerosolized epinephrine and steroids, persistence of tachycardia or tachypnea, and complex medical history (eg, prematurity, pulmonary or cardiac disease).

**167.3.** A 5-year-old immunized boy presents with stridor, low-grade fever, and nasal congestion. His family reports a barking-sounding cough. After initiating vaporized epinephrine, he appears well and is in no distress. The parents are requesting discharge. Which of the following would be the most appropriate next step in management?

- Administer dexamethasone (Decadron), observe the patient for 2 hours, and discharge if well.
- Admit the patient for overnight observation.
- Allow the patient to go home.
- Allow the patient to go home with a prescription of steroids.
- Observe the patient for 2 to 3 hours and then discharge if well.

**Answer: A.** The child has croup and, after being treated with vaporized epinephrine, should be observed for rebound stridor for a minimum of 2 hours. If the child is well, is in no respiratory distress, has a good hydration status, and is able to access emergency and follow-up care, he or she can then be safely discharged.

**167.4.** What is the ideal head position to assess a pediatric soft tissue radiograph of the neck for an upper airway pathology?

- Extension
- Extension during inspiration
- Flexion
- Flexion during inspiration
- Neutral

**Answer: B.** Gentle extension of the head gives the most accurate images, avoiding the artificial soft tissue widening that can be seen in flexion. Inspiration, if possible, allows maximal distention of the pharynx and the best viewing of soft tissue structures defined by an air–soft tissue interface.

**167.5.** Which of the following factors is least consistent with the diagnosis of peritonsillar abscess?

- A. Muffled, hot potato voice
- B. Pain radiating to the ear
- C. Patient 3 years of age
- D. Patient 13 years old
- E. Trismus

**Answer: C.** Peritonsillar abscess more commonly occurs in older children and teenagers, whereas retropharyngeal abscess is more common in a younger population. All the other signs or symptoms listed are consistent with peritonsillar abscess, along with deviation of the uvula away from the abscess side.

**167.6.** A 3-year-old immunized girl presents after a brief viral illness with progressive dyspnea, ill appearance, and high fever. The child is relatively still, appearing as if she is trying not to cough. Stridor is heard, and she does not respond to croup therapy. You notify the operating room, where the patient undergoes bronchoscopy, with suctioning and airway placement. Culture results are most likely to grow which of the following organisms?

- A. *Bacteroides fragilis*
- B. *Candida albicans*
- C. Parainfluenza
- D. *Staphylococcus aureus*
- E. *Streptococcus pneumoniae*

**Answer: D.** The case described is consistent with bacterial tracheitis. Although *Candida*, parainfluenza, and *Streptococcus* have all been reported, *S. aureus* is most common. Broad-spectrum antibiotics are appropriate, with an emphasis on covering *S. aureus*.

## KEY CONCEPTS

- An infant younger than 12 months has an oxygen consumption index double that of an adult. An infant with bronchospasm due to asthma or bronchiolitis may rapidly develop hypoxemia, bradycardia, and cardiopulmonary arrest.
- No single asthma score has been universally adopted to assess degree of illness or treatment responses. However, most scores include some combination of respiratory rate, degree of wheezing, inspiratory-to-expiratory ratio, use of accessory muscles, and oxygen saturation.
- It should not be a routine practice to obtain a chest x-ray for wheezing children, even for those who are febrile, wheezing for the first time, or require hospitalization. Chest x-rays are indicated for those with a history of choking, focal chest findings, extreme distress, or subcutaneous emphysema.
- Albuterol is the drug of choice in the ED treatment of acute asthma of any severity.
- Albuterol delivered by MDI-S is as effective as that delivered by nebulizer for children with acute asthma. The mode of delivery is largely chosen on the basis of cost and ability to adhere to the goal of three treatments within the first hour of care.
- Almost all children treated in the ED for asthma will require systemic corticosteroids. However, children with mild exacerbations who respond promptly to a single SABA treatment may be managed without systemic corticosteroids.
- To date, most studies have failed to demonstrate that levalbuterol leads to better ED outcomes compared with racemic albuterol. Racemic albuterol, at a substantially lower cost, should remain the drug of choice for children with acute asthma exacerbations.
- Continuously nebulized albuterol, CS, magnesium sulfate, and IV SABA are cornerstones of therapy for moderately to severely ill children with asthma.
- National guidelines recommend that emergency clinicians initiate controller therapy (eg, inhaled corticosteroids) for children with persistent asthma at ED discharge.
- Asthma is the condition that has the most clinical overlap with bronchiolitis. Physical examination findings alone cannot distinguish the two. Younger age, presentation during the winter months, antecedent URI symptoms, and absence of prior or family history of atopic disease and wheezing suggest bronchiolitis as the cause of wheezing in an individual patient.
- Bronchiolitis is a clinical diagnosis based on a history of prodromal URI symptoms in a young infant, followed by findings on physical examination of wheezing and increased work of breathing. The value of diagnostic imaging and laboratory evaluation is limited, and these measures should not be used routinely.
- A urinalysis and culture should be performed for febrile infants between 1 and 2 months of age who are known to be RSV-positive or have clinical bronchiolitis. The decision to obtain blood or cerebrospinal fluid cultures and give empirical antibiotics should be made on an individual basis.
- All febrile infants in the first month of life should undergo testing and evaluation for SBIs and be empirically treated with antibiotics, regardless of RSV status or presence of clinical bronchiolitis.
- The management of infants with bronchiolitis focuses largely on supportive measures, and most patients able to tolerate oral hydration can be managed as outpatients. There are currently no consistently effective pharmacologic therapies for bronchiolitis.
- Despite reports that more than 50% of infants may be prescribed corticosteroids when diagnosed with bronchiolitis, well-designed controlled trials have demonstrated no benefit for their use in terms of rate of admission, clinical score, or any other clinical outcome.
- Disposition from the ED for bronchiolitis depends on the assessment of multiple risk factors, including young age, prematurity, significant hypoxemia, and severe tachypnea, which may predict a more severe clinical course.

## CHAPTER 168: QUESTIONS &amp; ANSWERS

**168.1.** A 19-month-old girl with a history of asthma present with severe respiratory distress marked by wheezing, tachypnea, deep retractions, and an oxygen saturation of 92% in room air. She fails to improve 10 minutes after nebulized short-acting  $\beta_2$ -agonist (SABA) therapy and repeatedly tries to pull off her face mask. Which strategy is likely to produce the most rapid clinical benefits in this setting?

- A. Administering IM terbutaline
- B. Administering IV methylprednisolone
- C. Administering the SABA via metered-dose inhaler (MDI) instead of by nebulization
- D. Doubling the dose of SABA in the nebulizer reservoir
- E. Taking off her face mask and holding it close to her face to reduce her agitation

**Answer: A.** This patient's degree of bronchospasm and lack of cooperation make it difficult to deliver aerosolized medication effectively. In this setting, IM terbutaline is most likely to result in rapid bronchodilation, making subsequent aerosolized therapy more effective.

**168.2.** A 4-month-old male infant presents to the ED with his father, who reports that the patient has been wheezing. His vital signs are temperature, 102.2° F (39°C), respiratory rate, 50 breaths/min, and oxygen saturation, 97%. On examination, you find diffuse wheezing and copious nasal secretions. While in the ED, the patient does not have a wet diaper, and his father reports that he has had decreased oral (PO) intake for the past 2 days. Which of the following findings with bronchiolitis is not associated with the need for admission?

- A. Age
- B. Decreased PO intake
- C. Oxygen saturation
- D. Respiratory rate
- E. Temperature

**Answer: E.** Patients often in need of admission for bronchiolitis include those with respiratory rate more than 70 breaths/min,  $O_2$  saturations of 95% or less, age younger than 3 months, and poor feeding.

**168.3.** Which of the following side effects are seen with the use of intravenous magnesium in the treatment of asthma in children?

- A. Change in serum pH
- B. Development of a prolonged QT interval on the electrocardiogram
- C. Hypercalcemia
- D. Hyperkalemia
- E. Hypotension

**Answer: E.** Most patients who receive a magnesium infusion at the recommended dose will experience a clinically insignificant decrease in blood pressure. This may be minimized by infusing the medication over 20 minutes and by concurrently administer ing normal saline solution.

- 168.4.** You are about to treat a child with acute asthma with albuterol. Which of the following factors is most important when considering the method of aerosolized drug delivery?
- A. About 20% to 30% of nebulized drug reaches the alveoli.
  - B. Children receiving  $\beta$ -agonists by nebulizer (NEB) have similar outcomes compared with those using a metered-dose inhaler (MDI-S).
  - C. Children weighing > 20 kg should receive a maximum of four puffs of albuterol via MDI-S.
  - D. MDI-S therapy is more costly than NEB therapy.
  - E. The use of MDI-S for acute asthma is not supported by national guidelines.

**Answer: B.** Clinical trials and systematic reviews have repeatedly shown these two forms of therapy to be equivalent. With NEB treatment, less than 10% of nebulized drug reaches the alveoli. A recommended MDI-S dose for older children is eight puffs. Most studies demonstrate that MDI-S therapy is more cost-effective because of a slightly reduced need for hospitalization. National guidelines support the use of MDI-S to deliver albuterol to children with acute asthma.

- 168.5.** A 7-month-old male infant was diagnosed 2 days ago with bronchiolitis. He continues to have wheezing and increased work of breathing, prompting his parents to bring him into the ED because of a new-onset fever. Which of the following is the most likely secondary bacterial infection in this infant with bronchiolitis?
- A. Pneumonia
  - B. Acute otitis media
  - C. Meningitis
  - D. Urinary tract infection

**Answer: B.** Bacterial acute otitis media (AOM) is the most common condition associated with bronchiolitis, with a prevalence of up to 60%. The bacterial pathogens are similar to those recovered in other children with AOM; thus, it should be treated according to standard recommendations. Other concurrent bacterial infections are rare.



## KEY CONCEPTS

- Determining the causative agent of pneumonia by clinical presentation and radiographic findings is not reliable; empirical treatment is based on likely pathogens.
- Infants and younger children with pneumonia may have subtle or nonspecific symptoms and signs on presentation.
- First-line therapy for the treatment of bacterial pneumonia in children is amoxicillin as an outpatient and ampicillin as an inpatient.
- Pertussis should be considered in a young infant with a staccato cough or episodes of cyanosis.
- *M. pneumoniae* and *C. pneumoniae* may play a role in pneumonia in a younger child.
- In patients with CF, defects in chloride transport across the airway epithelium result in reduced ciliary clearance of thickened mucus, which results in an increased likelihood for pneumonia, especially that caused by *P. aeruginosa*.
- CF may respond favorably to bronchodilator therapy and mucolytics, such as inhaled *N*-acetylcysteine.
- Patients with BPD have increased airway resistance, decreased lung compliance, and obstructive lung disease; reactive airway disease and pneumonia are common in these patients.

## CHAPTER 169: QUESTIONS &amp; ANSWERS

- 169.1.** A 5-month-old boy presents with a cough. His parents report that for the past several weeks he has had mild respiratory tract symptoms and cough; however, during the past day, he has developed a severe paroxysm of staccato cough followed by posttussive emesis. What is the most appropriate antibiotic choice for this patient?
- A. Amoxicillin
  - B. Ampicillin
  - C. Ceftriaxone
  - D. Erythromycin
  - E. Trimethoprim-sulfamethoxazole

**Answer: D.** This patient likely has pneumonia caused by *Bordetella pertussis*. All children younger than 6 months with presumed pertussis should be observed in the hospital for monitoring and supportive care and treated with erythromycin. Other macrolides and trimethoprim-sulfamethoxazole are other possible alternatives. Amoxicillin and ceftriaxone are used to treat other types of pneumonia.

- 169.2.** Which of the following findings is necessary to make the diagnosis of pneumonia in children requiring admission to the hospital?
- A. Abnormal chest radiograph showing pulmonary infiltrates
  - B. Fever and decreased breath sounds unilaterally
  - C. Fever and rales
  - D. Rales and tachypnea

**Answer: A.** A chest radiograph showing pulmonary infiltrates is necessary to make the diagnosis of pneumonia in children who are ill. The World Health Organization does allow for clinical signs and symptoms, such as tachypnea, for the diagnosis of pneumonia in resource-poor areas. However, in the United States with easy

access to radiological services, children should have an abnormal radiograph showing pulmonary infiltrates prior to hospitalization for the diagnosis of pneumonia. Infectious Disease Society of America guidelines allow for the treatment of clinical pneumonia if community-acquired pneumonia (CAP) is strongly suspected and the child does not have respiratory distress.

- 169.3.** Which of the following statements best describes the epidemiology of pneumonia in children?
- A. *Bordetella pertussis* is the most common cause in infants.
  - B. *Haemophilus influenzae* type b is still an important pathogen.
  - C. *Listeria monocytogenes* may cause illness in children younger than the age of 5 years.
  - D. Viral agents are the most common cause of pneumonia in children overall.

**Answer: D.** Viral agents are the most common cause of pneumonia in children. Bacteria predominate in neonates but are less common causative agents in toddlers and older children. Although *L. monocytogenes* may cause pneumonia in infants, it is unusual after 3 months of age. *H. influenzae* type B has decreased by 90% since the onset of immunization of infants and young children.

- 169.4.** What is the most common viral agent causing pneumonia in infants younger than 1 year?
- A. Adenovirus
  - B. Enterovirus
  - C. Epstein-Barr virus
  - D. Respiratory syncytial virus (RSV)

**Answer: D.** RSV and parainfluenza are the most common viral agents in infants younger than 1 year. Viruses that may be responsible for the other agents may also cause viral pneumonia but are not as common as RSV.

**169.5.** Which of the following conditions may predispose children to a bacterial pneumonia?

- A. All of these
- B. Cystic fibrosis
- C. Foreign body aspiration
- D. Immunosuppression

**Answer: A.** All these conditions predispose children to severe pneumonia—foreign body aspiration because of obstruction and resulting inflammation with secondary infection, immunosuppression with unusual organisms such as *Pseudomonas*, and cystic fibrosis, for the inability to clear mucus in the lung itself, resulting in increased risk of infection.

**169.6.** A 2-month-old presents with a persistent cough for 2 weeks and intermittent episodes of posttussive vomiting. Which of the following tests is the most accurate to establish a diagnosis?

- A. Blood culture
- B. Direct fluorescent antibody
- C. Polymerase chain reaction assay of nasal aspirate
- D. Sputum culture

**Answer: C.** This clinical scenario depicts a young infant with possible pertussis. Although culture may be highly specific, it often yields false-negative results. The most accurate test at this time is the polymerase chain reaction. Blood cultures are unreliable in cases of pertussis and are only positive in less than 10% of children with bacterial pneumonia overall.

**169.7.** Which of the following strategies has been shown to be most effective in decreasing the rates of pertussis in infants?

- A. Postexposure prophylaxis with a macrolide for family members of index cases
- B. Vaccination of all infants at 2 months of age
- C. Vaccination of health care workers in the adult population
- D. Vaccination of school-age children

**Answer: C.** Vaccination of health care workers in the adult population with Tdap (tetanus, diphtheria, pertussis) has been shown to decrease rates of pertussis in children. All other strategies have been less effective.

**169.8.** A 2-year-old presents with fever, cough and rales. Chest radiograph reveals right middle lobe pneumonia. Which of the following antibiotics would be recommended for outpatient treatment for this toddler who is not penicillin allergic?

- A. Amoxicillin
- B. Azithromycin
- C. Ceftriaxone
- D. Cephalexin

**Answer: A.** High-dose amoxicillin, 90 mg/kg/day, divided tid is the treatment of choice for children with pneumonia younger than 5 years. Once the child reaches school age, then macrolides (eg, azithromycin) are suggested as empirical therapy because of the increased risk of *Mycoplasma pneumoniae* infection.

## KEY CONCEPTS

- The possibility of a congenital heart defect should be considered in an infant who presents with central cyanosis that does not respond to 100% supplemental oxygen (hyperoxia challenge).
- Neonates with ductal-dependent cardiac lesions typically present within the first 2 to 3 weeks of life with either acute cyanosis or shock. Initiation of a prostaglandin E<sub>1</sub> (PGE<sub>1</sub>) infusion (0.05 to 0.1  $\mu$ g/kg/min) will be lifesaving in these neonates.
- Treatment of a hypoxic tet spell first includes the placement of an infant in the knee-to-chest position or of an older child in a squatting position to increase systemic vascular resistance (SVR) and the provision of supplemental oxygen. Sedative agents can be used to decrease hyperpnea. Various medications can be used as adjunctive treatment to increase the SVR and thereby decrease the degree of right-to-left shunting across the ventricular septal defect (VSD).
- Prompt recognition of the clinical findings and symptoms of Kawasaki disease along with the rapid initiation of high-dose aspirin and intravenous immune globulin (IVIG) infusion can prevent the formation of coronary aneurysms.
- Acute bacterial endocarditis should always be considered in a child with a known congenital heart defect or an acquired cardiac defect who presents with fever of unknown origin, acute neurologic deficits, new-onset microscopic hematuria, myalgias, splenomegaly, petechiae, or other signs of systemic embolization.
- Oxygen, positive pressure ventilation (noninvasive or invasive), diuretics, and possibly inotropes are the main emergency department (ED) treatment of infants and children who present with congestive heart failure (CHF).
- If vagal maneuvers fail to convert stable paroxysmal supraventricular tachycardia in children, rapid adenosine administration (0.1 mg/kg for the first dose, followed by 0.2 mg/kg on repeated doses) is the treatment of choice. Verapamil should be avoided in children younger than 1 year old because of its profound hypotensive effects.
- Consider the use of lidocaine instead of amiodarone in cases of ventricular fibrillation or ventricular tachycardia due to medications (eg, cyclic antidepressants) or toxins that prolong the QT interval.
- Young athletes with a positive family history of sudden unexplained death or exertion-induced symptoms (such as, chest pain, dyspnea, palpitations, and syncope) should be evaluated by a cardiologist before their resumption of vigorous activity.
- The increased presence of automated external defibrillators (AEDs) in public places and at sporting events can potentially save the lives of more young athletes who suddenly collapse secondary to hypertrophic cardiomyopathy, prolonged QT syndromes, and commotio cordis.

## CHAPTER 170: QUESTIONS &amp; ANSWERS

**170.1.** Which of the following congenital heart diseases (CHDs) requires a patent ductus arteriosus to preserve blood flow from the main pulmonary artery to the systemic circulation?

- A. Pulmonary atresia
- B. Severe aortic stenosis
- C. Tetralogy of Fallot
- D. Transposition of the great vessels
- E. Tricuspid atresia

**Answer: B.** Pulmonary atresia, tetralogy of Fallot, transposition of the great vessels, and tricuspid atresia are also ductal-dependent lesions, but they require a patent ductus arteriosus (PDA) to preserve blood flow from the aorta to the pulmonary circulation.

**170.2.** Which of the following is considered a cyanotic congenital heart defect (CHD)?

- A. Aortic stenosis
- B. Atrial septal defect (ASD)
- C. Coarctation of the aorta
- D. Tetralogy of Fallot
- E. Ventricular septal defect (VSD)

**Answer: D.** Aortic stenosis, ASD, coarctation of the aorta, and VSD are all considered acyanotic CHDs. The classic cyanotic CHDs can be remembered by the “five Ts”: truncus arteriosus, transposition of the great vessels, tricuspid atresia, tetralogy of Fallot, and total anomalous pulmonary venous return.

**170.3.** Which of the following increases the systemic vascular resistance (SVR), thus producing a left-to-right shunt through the ventricular septal defect (VSD) associated with tetralogy of Fallot?

- A. Acute hypovolemia
- B. Crying
- C. Defecation
- D. Squatting
- E. Tachycardia

**Answer: D.** Squatting or knee-to-chest positions increase the SVR, thus improving tet spells by producing the left-to-right shunt. Acute hypovolemia, crying, defecation, and tachycardia are all events that suddenly lower the SVR and produce large right-to-left shunts across the VSD, beginning the vicious cycle of a hypoxic (“tet”) spell.

**170.4.** A 14-year-old girl presents to the emergency department (ED) with altered level of consciousness and trouble breathing. Her vital signs are blood pressure (BP), 72/39 mm Hg; heart rate, 240 beats/min; temperature, 99.6° F; respiratory rate, 60 breaths per minute; and oxygen saturation, 80%. An electrocardiogram (ECG) is performed, which shows supraventricular tachycardia. The patient weighs 50 kg. Which of the following is the most appropriate initial treatment?

- A. Adenosine 5 mg IV
- B. Cardioversion with 50 J
- C. Cardioversion with 200 J
- D. Diltiazem 12.5 mg IV
- E. Vagal maneuvers

**Answer: B.** This patient should be considered unstable supraventricular tachycardia (SVT), with trouble breathing, low O<sub>2</sub> saturation, and hypotension. In stable patients, vagal maneuvers may be appropriate to try first, followed by adenosine. Diltiazem may be used for rate control in patients with atrial flutter or atrial fibrillation. Cardioversion is the treatment of choice in patients with hemodynamic instability and SVT. The dose is 0.5 to 1 J/kg.

**170.5.** What is the most common cause of bradycardia in infants?

- A. Complete heart block
- B. Hypothermia
- C. Hypothyroidism
- D. Hypoxia
- E. Medication induced

**Answer: D.** Although all of these may cause bradycardia in infants and children, the most common cause is hypoxia.

**170.6.** A 16-year-old boy presents with complaints of syncope during a basketball game. His mother reports a family history of sudden death in young adults, and you are concerned that the patient may have hypertrophic cardiomyopathy. Which of the following increases the murmur associated with this condition?

- A. Hand grip
- B. Methoxamine
- C. Passive leg elevation
- D. Squatting
- E. Valsalva

**Answer: E.** During the Valsalva maneuver, the venous blood return to the heart is decreased, which in turn transiently reduces the left ventricular size. This transient reduction will increase the degree of obstruction and thus cause an increase in the intensity of the murmur. Hand grip, methoxamine, passive leg elevation, and squatting will increase return of blood to the heart and therefore decrease the murmur associated with hypertrophic cardiomyopathy.

**170.7.** A 3-year-old child (15 kg) is in pulseless ventricular tachycardia after being struck in the chest. The patient remains in pulseless ventricular tachycardia despite two doses of defibrillation, one dose of intravenous epinephrine, and high-quality cardiopulmonary resuscitation. The team leader prepares for the third dose of defibrillation to be delivered with a dose of amiodarone. What is the appropriate dose of defibrillation to deliver for this third defibrillation?

- A. 15 joules
- B. 30 joules
- C. 45 joules
- D. 150 joules

**Answer: D.** The first dose of defibrillation should be 2 joules/kg (which would be 30 joules in this 15-kg child). The second dose of defibrillation should be 4 joules/kg (which should be 60 joules in this 15 kg child). The new 2010 pediatric advanced life support (PALS) guidelines recommend that the third and subsequent defibrillation doses be 4 to 10 joules/kg. Therefore the third and subsequent defibrillation doses could be as high as 150 joules. Choice D of 150 joules is within the recommended range of 4 to 10 joules/kg.

In summary:

- First shock: 2 joules/kg
- Second shock: 4 joules/kg
- Subsequent shocks: 4 to 10 joules/kg up to maximum adult dose for the defibrillator

**170.8.** A 15-year-old boy is sent to the emergency department (ED) from his primary care doctor for further evaluation of “high blood pressure (BP)” recorded in the clinic today on a routine visit. He has no past medical history or symptoms. On examination, his BP is 150/90; when you palpate his radial and femoral pulses simultaneously, there is a marked pulse delay. Which of the following statements regarding this patient’s most likely diagnosis is *true*?

- A. On chest radiograph, the absence of rib-notching rules out the diagnosis.
- B. This is an isolated congenital finding; there are no other structural or valvular lesions associated with this condition.
- C. The majority of cases involve a lesion distal to the ductus arteriosus.
- D. This is a normal variant, and referral back to his primary medical doctor for follow-up is indicated.

**Answer: C.** This boy has classic findings of asymptomatic coarctation of the aorta (CoA). Dilated collateral vessels are under pressure, causing notching of the posterior ribs, typically seen after 5 years of age. Their absence, however, does not rule out this diagnosis. Up to 50% of patients with CoA have an associated bicuspid aortic valve. Although the coarctation can occur proximal to the insertion of the ductus arteriosus or within the duct itself, the majority (89%) of cases are the postductal type. Weaker or delayed pulses in the lower extremities are common in CoA; BP measurements in all four extremities are indicated if there is any suspicion. This is not a normal variant, and this asymptomatic patient’s evaluation should include an electrocardiogram (ECG; to assess left ventricular hypertrophy) and chest radiograph (to assess cardiomegaly, pulmonary vascular markings). Diagnosing the asymptomatic child with CoA and expediting definitive surgical repair can prevent the complications of severe untreated hypertension, including cardiomyopathy, heart failure, renal failure, and intracranial hemorrhage.

**170.9.** A 5-month-old girl presents with fever for a week, rash, and fussiness; reportedly yesterday her rash was faint throughout her body and has since resolved. On examination, she is febrile with otherwise reassuring vital signs; she is fussy and has conjunctival injection in both eyes. Her parents think she got sick from their other children. Which of the following statements regarding this patient’s most likely disease is *true*?

- A. If present, other systemic signs (such as, nausea, vomiting, and diarrhea) suggest an alternative diagnosis (such as, acute gastroenteritis).
- B. Laboratory investigation in the emergency department (ED) will assist in her risk stratification.
- C. Older children are at the highest risk for aneurysm formation.
- D. She does not need further testing because she has only one of four criteria at the present.

**Answer: B.** Kawasaki disease is a systemic vasculitis, and gastro intestinal findings (nausea, vomiting, abdominal pain, diarrhea) and neurologic findings (irritability, positive pleocytosis on lumbar puncture if done) may mislead the clinician. Although she only has one criterion currently, signs of Kawasaki disease may occur in series or simultaneously over the course of the disease. With two or more signs in a child who is febrile for more than 5 days, markers of systemic inflammation (such as, C-reactive protein [CRP] and erythrocyte sedimentation rate [ESR]) are indicated to determine the need for further laboratory testing (complete blood count, liver function tests [LFTs], albumin, urinalysis), imaging (echocardiography), or next day follow-up (with repeat laboratory tests). This child is at high risk because infants are more prone to vascular complications (such as, giant aneurysm formation); tragically they are also more likely to present with incomplete Kawasaki disease and may be overlooked. Accordingly, consensus guidelines recommend that all infants younger than 6 months old with fever of 1 week or greater (regardless of other findings) should undergo laboratory testing for markers of inflammation and, if positive, should have an echocardiogram performed emergently.

## KEY CONCEPTS

- Physiologic jaundice of the newborn and breast milk jaundice are the most common causes of jaundice in the neonatal period.
- Direct hyperbilirubinemia in infants is always pathologic and requires a detailed evaluation.
- Hypertrophic pyloric stenosis is associated with gradually progressive nonbilious emesis that becomes projectile.
- Hypochloremic-hypokalemic metabolic alkalosis is the classic electrolyte derangement associated with hypertrophic pyloric stenosis.
- Bilious vomiting in the neonate should initiate a diagnostic evaluation for possible malrotation with volvulus or other intestinal obstructive pathology.
- Toxic-appearing infants with bilious emesis should receive an emergent surgical consultation.
- Necrotizing enterocolitis occurs more commonly in premature infants, but 10% of affected infants are full term. Pneumatosis intestinalis—intramural air seen on x-ray—is pathognomonic for NEC.
- Gastroesophageal reflux (GERD) is very common in infants and is usually benign and self-limited. Occasionally, GERD may cause more severe symptoms, including irritability, respiratory distress, and failure to thrive. GERD usually responds to conservative measures (eg, positioning, thickening of formula, smaller and more frequent feedings); pharmacologic interventions are seldom needed.
- The classic clinical triad of intussusception includes colicky, intermittent abdominal pain, a palpable sausage-shaped abdominal mass, and bloody stools; however, the triad occurs in less than one-third of patients.
- Children with intussusception may present atypically, with an altered level of consciousness (eg, lethargy) rather than abdominal pain.
- Hirschsprung's disease is a common cause of constipation in the neonate and usually manifests as delayed passage of meconium. Occasionally, children may present later in life with symptoms of chronic constipation. Toxic megacolon is the most serious complication.
- Meckel's diverticulum classically manifests in children younger than 5 years, with massive, painless, brick red rectal bleeding.
- More than 90% of GI foreign bodies pass without complications.
- Button batteries lodged in the esophagus may cause serious burns, erosions, and perforations within as little as 2 hours. Of all foreign bodies, button batteries require the most expeditious removal, usually by endoscopy.
- Appendicitis is the most common surgical disease in children. Diagnosis depends on a combination of clinical factors, including history, physical examination, laboratory values, and imaging studies. The ideal diagnostic algorithm remains elusive.
- Effective imaging strategies for children with suspected appendicitis include initial ultrasound examination followed by CT scanning of the abdomen for those with equivocal findings.
- Causes of pancreatitis in children include viruses, trauma, drugs, and toxins.
- Biliary disease in children is more commonly caused by cholestasis rather than biliary obstruction.
- Pigment gallstones are more common than cholesterol stones in children. Biliary tract disease is usually diagnosed with right upper quadrant ultrasound imaging; management strategies are similar to those for adults.

## CHAPTER 171: QUESTIONS &amp; ANSWERS

- 171.1.** What is the most common cause of jaundice in the newborn?
- Breast milk jaundice
  - Crigler-Najjar syndrome
  - Gilbert's syndrome
  - Physiologic jaundice of the newborn
  - Toxoplasmosis, other (congenital syphilis and viruses), rubella, cytomegalovirus, and herpes simplex virus (TORCH) infection

**Answer: D.** Although each of these may be a cause of hyperbilirubinemia in the newborn, the most common cause of jaundice is physiologic jaundice of the newborn.

- 171.2.** A 4-week-old white infant presents with projectile vomiting. The mother denies that the patient has a history of fevers, irritability, or signs suggestive of abdominal pain. On physical examination, you palpate an olive in the patient's right epigastrium. Which of the following laboratory abnormalities would you expect to find?
- Hyperchloremia and hypokalemia
  - Hyperglycemia and hypokalemia
  - Hyponatremia and hyperkalemia
  - Hypochloremia and hypokalemia
  - Hyponatremia and hyperkalemia

**Answer: D.** This patient likely has pyloric stenosis. As vomiting continues, the infant loses hydrogen and chloride ions through emesis of gastric juices. As this metabolic derangement worsens, the kidney attempts to retain hydrogen ions by substituting potassium, resulting in a hypochloremic-hypokalemic metabolic alkalosis.

- 171.3.** An 11-month-old infant presents with vomiting. The patient's mother reports that he has been crying out in pain intermittently throughout the day, at which times he brings his knees to his abdomen. In between these episodes, the patient acts normally and plays. He has not had a fever, but the mother complains that his stool earlier looked like currant jelly. On examination, you find a playful afebrile patient, with a soft nontender abdomen. Which of the following may be used as an initial screening examination?
- Air contrast enema
  - Barium enema
  - Computed tomography scan of the abdomen-pelvis
  - Ultrasound
  - Upper endoscopy

**Answer: D.** The initial screening examination for intussusception is abdominal ultrasonography. Although each of the other imaging modalities may be useful to exclude other diagnoses or identify intussusception, ultrasonography has high sensitivity and specificity and is the screening modality of choice.



## KEY CONCEPTS

## Identification of Pathogen

- Stool studies are not indicated in most uncomplicated cases of acute gastroenteritis (AGE). Exceptions are those cases in which specific treatment, specific prophylaxis, or health precautions are required, or in which the patient has systemic involvement, underlying medical complications, or the illness involves dysenteric features.
- Antibiotics are not required for most cases of uncomplicated acute bacterial enteritis. Antibiotics are recommended routinely for *Campylobacter*, *C. difficile*, *Giardia intestinalis*, and *E. histolytica*. Antibiotics can be considered for *Cryptosporidium*, traveler's diarrhea, and *Shigella* (because antibiotics have been shown to decrease diarrhea and eradicate organisms in the stool).
- Patients with Shiga toxin-producing *E. coli* (STEC) should not empirically receive antibiotics, because they may increase the risk of hemolytic-uremic syndrome (HUS).
- Testing for fecal leukocytes is a useful initial test because it may support a diagnosis of invasive disease. This test should be considered in children with diarrhea who are febrile or have mucus or blood in the stool. If the test result is positive, stool culture is indicated to further guide management.

## Oral Rehydration

- Most patients with mild to moderate dehydration can be treated with oral rehydration therapy (ORT). Resumption of feeding with

age-appropriate diets should begin as soon as vomiting subsides. Routine fasting with infectious diarrhea is not recommended.

## Dehydration Assessment

- The degree of volume depletion is estimated from the history and physical examination findings. The desired volume of oral rehydration solution is calculated as 30 to 50 mL/kg for mild dehydration and 60 to 80 mL/kg for moderate dehydration; 25% of the volume of oral rehydration solution is to be replaced every hour (100% over 4 hours). Continue to replace ongoing losses with 10 mL/kg for each diarrheal stool and 2 mL/kg for each vomiting episode.

## Severe Dehydration

- In severe dehydration, 20 mL/kg of 0.9% saline (or other appropriate isotonic crystalloid solution) given intravenously at a rapid rate should reverse signs of shock within 5 to 15 minutes. Repeated boluses of 20 mL/kg are indicated until clinical improvement occurs, but volume requirements greater than 60 mL/kg without signs of improvement suggest other conditions, such as septic shock, hemorrhage, capillary leak with third-space fluid sequestration, and heart failure.

## CHAPTER 172: QUESTIONS &amp; ANSWERS

**172.1.** A 5-month-old male infant presents in December with a 1-day history of fever to 38.3° C, emesis, and multiple episodes of foul-smelling, greenish, watery diarrhea. Physical examination reveals an awake but tired baby with a sunken fontanel, dry mucous membranes, decreased skin turgor, and irritated skin in the diaper area. What is the most likely cause of this patient's gastroenteritis?

- A. *Astrovirus*
- B. *Escherichia coli*
- C. Norwalk virus
- D. *Rotavirus*
- E. *Salmonella* spp.

**Answer: D.** The child described most likely has diarrhea caused by rotavirus. *Rotavirus* is the most common cause of acute diarrheal illnesses in infants and toddlers. Norwalk virus and *E. coli* are not common causes of diarrhea in young infants. *Astrovirus* is a cause of diarrhea in children younger than 4 years old, but most of the infections are asymptomatic. *Salmonella* spp. also causes diarrhea in infants, but it is much less common.

**172.2.** For which of the following patients should the emergency clinician not obtain diagnostic testing of the stool?

- A. 1-month-old with fever to 38° C with bloody diarrhea
- B. 8-month-old with sickle cell disease with fever and diarrhea
- C. 12-month-old, well-appearing child with 2 days of watery diarrhea
- D. 2-year-old with nephrotic syndrome on prednisone with diarrhea and fever for 3 days
- E. Community outbreak of diarrhea

**Answer: C.** Most children with uncomplicated gastroenteritis or acute diarrhea do not need laboratory studies. Stool cultures are useful and important to obtain in febrile infants and children with blood in their stools, in community outbreaks, and in the immunosuppressed.

**172.3.** A 4-year-old child presents with moderate dehydration from gastroenteritis. He is still actively vomiting. Which of the following statements regarding this patient's rehydration is correct?

- A. A nasogastric tube should be placed for rehydration.
- B. Oral rehydration should not be started.
- C. Oral rehydration success can be determined in 2 or 3 hours.
- D. Oral rehydration target volume is 80 mL/kg.
- E. Target oral rehydration volume should be administered over 2 hours.

**Answer: D.** Oral rehydration can be effective even in the face of vomiting in cases of mild or moderate dehydration. Target oral volumes are 60 and 80 mL/kg, respectively. Nasogastric tubes may occasionally be useful but should not be used unless oral rehydration therapy (ORT) fails. The target oral volume should be given in doses of 25% of total replacement per hour over 4 hours.

**172.4.** A 9-year-old child with a history of sickle cell disease presents for evaluation of fevers, diarrhea, and vomiting. The parents say the patient has not had a sickle cell crisis in almost a year. On examination, the vital signs are stable and the child is nontoxic appearing with mild dehydration. His abdominal examination is benign. In addition to rehydration, which of the following would be the most appropriate management and disposition for this child?

- A. Obtain blood cultures and admit for observation.
- B. Obtain cultures (stool and blood), begin antibiotics, continue hydration, and admit for observation.
- C. Obtain electrolytes; and if he has a normal bicarbonate level, then discharge home.
- D. Perform a stat rotazyme assay; and if negative and patient tolerates oral intake, then discharge home
- E. Provide oral rehydration therapy (ORT); and if successful, then discharge home.

**Answer: B.** Patients with sickle cell disease are more susceptible to *Salmonella* infections and are at increased risk for complications. It has been shown that giving antibiotics to patients with nontyphoidal *Salmonella* has been ineffective in shortening the duration of symptoms and prolonging the carrier state. Therefore antibiotics are generally not recommended for asymptomatic cases or for uncomplicated cases. However, antibiotic treatment is indicated in infants younger than 3 months old or those with complications, such as failure to improve within 5 to 7 days; bacteremia; focal infection in the central nervous system (CNS), bone, joint, kidney, or pericardium; or those with immunosuppressive conditions, hemoglobinopathies, malignant neoplasms, human immunodeficiency virus (HIV), or chronic gastrointestinal disease. The recommended antibiotics are for unknown susceptibility or in areas of high resistance to use ceftriaxone or cefotaxime until susceptibility is known. Ampicillin and trimethoprim-sulfamethoxazole (TMP-SMX) may also be effective, but they should only be used in high-risk individuals once susceptibility is known.

## KEY CONCEPTS

**Priapism**

- In low-flow priapism, cavernosal aspiration plus irrigation has been effective when performed within the first 48 hours, and preferably within a few hours, of symptom onset. Phentolamine, phenylephrine, ephedrine, or 1:1,000,000 epinephrine can be added to the irrigation solution used in performing corporal aspiration.

**Phimosis and Paraphimosis**

- Steroid cream is first-line therapy for phimosis. In paraphimosis, most can be reduced utilizing a number of techniques, only in severe cases involving vascular compromise of the glans penis, may a dorsal slit procedure may be necessary.

**Testicular Torsion**

- Delay in diagnosis and treatment can result in loss of spermatogenesis and, in severe cases, a necrotic, gangrenous testis.
- Color Doppler ultrasonography is the test of choice, but false negatives due occur.
- Testicular salvage rates are 96% if detorsion is performed less than 4 hours after symptom onset; with more than a 24-hour delay, the salvage rate falls to less than 10%.

**Varicoceles**

- Left-sided varicoceles account for 85 to 95% of the cases.
- Right-sided varicoceles are often caused by inferior vena cava thrombosis or compression by tumors.

**Urinary Tract Infections**

- In children younger than 2 years, a urinalysis alone is inadequate to rule out a urinary tract infection; urinalysis yields false-negative results in 10%–50% of patients. Urine cultures should be sent in children less than 2 years of age.
- Girls less than 2 years old, and boys, uncircumcised, less than 1 year, and circumcised less than 6 months are at higher risk for UTIs.
- Children less than 2 years old should be considered to have upper tract disease and receive antibiotic treatment for 7–14 days.

**Renal Stones**

- Renal stones are more common than ureteral stones in younger children.
- Older children can present with classic renal stones signs and symptoms; younger children may present with more non-specific symptoms, such as malaise and non-tender abdominal pain.

- Ultrasound should be the first-line imaging modality used in children with suspected renal stones.

**Poststreptococcal Glomerulonephritis**

- Patients will present with a history of a pharyngeal or skin infection in the previous 2–6 weeks; clinical findings are usually limited to the urinary tract including hematuria, flank pain or sometimes generalized edema.
- Diagnostic testing will show blood, protein, and RBC casts in the urine; evidence of renal dysfunction (elevated BUN) and low complement levels will also be found.
- Treatment includes restricting fluid and diuretics for more significant disease.

**Nephrotic Syndrome**

- Albumin and immunoglobulin levels are typically both decreased in nephrotic syndrome.
- Clinical signs include periorbital edema, weight gain, and more serious signs such as pulmonary edema or ascites.
- Children with nephrotic syndrome are at increased risk for thrombosis and bacterial infections, especially *Streptococcus* and *E.coli*.
- Treatment includes corticosteroids and diuretics.

**Henoch-Schönlein Purpura (HSP)**

- HSP is an immunoglobulin A-mediated systemic vasculitis that involves the skin, GI tract, joints, and kidneys.
- Urinalysis may be positive for blood and RBC casts.
- Corticosteroids can be useful for severe abdominal pain.

**Hemolytic-Uremic Syndrome (HUS)**

- HUS is a microangiopathic hemolytic anemia found in young children. In the U.S., it is typically related to Shiga-toxin producing *E.coli* (STEC), presenting with abdominal pain and bloody diarrhea. *Streptococcus pneumoniae* has also been implicated.
- Renal vascular endothelium injury results in renal insufficiency and damage to RBCs; glomerular damage occurs due to platelet, complement, and fibrin deposits.
- Peripheral smear will show damaged RBCs and typically thrombocytopenia; renal involvement ranges from hematuria to elevated BUN and creatinine.
- Stool cultures and Shiga toxin testing should be sent in diarrhea-associated cases.
- Antibiotics are not indicated in HUS unless a concurrent presumptive pneumococcal infection such as pneumonia is present.

## CHAPTER 173: QUESTIONS &amp; ANSWERS

- 173.1. A 12-year-old boy presents with engorgement of the dorsal corpora cavernosa. You expect to elicit which of the following in his history?
- Early sexual intercourse
  - Recent trauma
  - Sexual abuse
  - Sickle cell disease
  - Testicular mass

**Answer: D.** Priapism is the engorgement of the dorsal corpora cavernosa, resulting in dorsal penile erection and ventral penile flaccidity. Sickle cell disease and leukemia are responsible for most cases in children.

- 173.2. A 17-year-old uncircumcised adolescent presents complaining of pain and swelling of his penis. On physical examination, you find a grossly edematous glans and distal shaft, with a retracted prepuce that is unable to be reduced. There is evidence of cellulitis. Compression and manual reduction have been unsuccessful. What is the next step in the management of this patient?
- Administer local anesthesia, lubrication, and forceful reduction.
  - Perform a dorsal slit followed by admission to the hospital.
  - Prescribe oral antibiotics and follow-up in 24 hours.
  - Prescribe topical antibiotics and antifungal agents and follow-up in 1 week.

**Answer: B.** Paraphimosis is the inability to retract the foreskin over the glans and represents a true urologic emergency. Ice, circumferential compression, and manual reduction are all ways to reduce the foreskin. If all attempts fail, urologic consultation and circumcision or a dorsal slit procedure may be necessary. Any evidence of cellulitis or necrosis warrants admission to the hospital, intravenous antibiotics, and urologic consultation. To achieve pain control using a local procedure, a dorsal penile nerve block should be attempted. Injection of anesthetic to the glans will add to the swelling and difficulty with reduction.

- 173.3. A 5-year-old boy presents with pain, swelling, and redness of his penis. You note inflammation of the glans and foreskin. Which of the following is indicated?
- A. Antibiotics, sitz baths, and hydrocortisone cream
  - B. Complete blood count with differential, blood cultures, and urine cultures
  - C. Incision and drainage
  - D. Topical antibiotics and wet to dry dressing
  - E. Urinalysis and urethral swab

**Answer: A.** Balanoposthitis is an inflammation that involves the glans and foreskin, whereas balanitis is just involvement of the glans. Infectious organisms include gram-negative and gram-positive organisms, including group A beta-hemolytic streptococci and, rarely, *Neisseria gonorrhoeae* and *Chlamydia*. Management includes emphasis on adequate hygiene with sitz baths to reduce inflammation. In patients with cellulitis, treatment against *Staphylococcus aureus* and *Streptococcus pyogenes* is recommended.

- 173.4. A 13-year-old boy presents with pain, swelling, and discoloration of his left testicle. Prior to the testicular changes, he had a fever and mild facial swelling. What is the most appropriate next best step in the management of this patient?
- A. Admission for antibiotics and serial examinations
  - B. Color flow Doppler ultrasound
  - C. Inquiry about sexual encounters
  - D. Pain management and reassurance
  - E. Urology consult for surgical management

**Answer: B.** During the course of mumps, orchitis usually develops after the first week and presents with tenderness and edema of the testis, with discoloration of the scrotum. With the limited information in this case, it is not clear that this patient does not have testicular torsion. Doppler ultrasound may be necessary to distinguish orchitis from testicular torsion. For patients with a clear viral origin such as mumps, treatment is aimed at pain control (eg, scrotal elevation, nonsteroidal antiinflammatory drugs, possibly narcotics).

- 173.5. Which of the following statements about testicular torsion is false?
- A. Indeterminate ultrasound requires urology consult.
  - B. Intravaginal torsion results from rotation of the testis inside the tunica vaginalis.
  - C. Most patients with testicular torsion are infants.
  - D. Predilection for torsion exists if the tunica vaginalis completely covers the testis.
  - E. The presence of the cremasteric reflex does not preclude torsion.

**Answer: C.** Most patients are adolescents, although testicular torsion can be seen at any age. If the tunica completely covers the testis and attaches higher up on the spermatic cord, proper testicular fixation does not occur and there is a predisposition to torsion. In intravaginal torsion, the testicle may rotate within the tunica vaginalis and thereby constrict the arterial blood flow. The

presence of the cremasteric reflex does not preclude testicular torsion. Results of a urinalysis are rarely helpful because pyuria can be seen in cases of testicular torsion and epididymitis. In cases of indeterminate ultrasound results, the urology consultant should be notified for disposition decisions.

- 173.6. A mother brings in her 2-year-old child after she noticed a pink tinge on the diaper when she was changing her child. Which of the following is not part of the differential diagnosis?
- A. Blueberry ingestion
  - B. Henoch-Schönlein purpura
  - C. Red apple ingestion
  - D. *Serratia marcescens*
  - E. Urate crystals

**Answer: C.** Not all red urine contains blood. Certain drugs or foods, such as phenothiazines, ibuprofen, beets, and blueberries, can cause reddish-colored urine; apples, however, do not. In neonates, urate crystals can cause red-tinged urine in the diaper. *Serratia marcescens*, a fecal pathogen, can cause a red pigmentation when left in the diaper. Bleeding from the vagina or rectum can sometimes be mistaken for blood in the urine. Systemic illnesses such as Henoch-Schönlein purpura and hemolytic-uremic syndrome can cause hematuria.

- 173.7. A 5-year-old boy presents with flank pain and hematuria. He was recently treated with penicillin for a throat infection. Urinalysis demonstrates blood, protein, and red blood cell casts. Which test will be most helpful in establishing a diagnosis in this patient?
- A. ASO titer
  - B. Complement levels
  - C. Hyaline casts
  - D. Serum sodium and osmolarity
  - E. Urine electrolytes

**Answer: A.** This is likely poststreptococcal glomerulonephritis. The ASO and immunoglobulin G levels should be elevated. Total complement levels, especially C3, are decreased in most patients during the first 2 weeks of the illness. The complement levels should return to normal within 3 or 4 weeks. The blood urea nitrogen (BUN) level is elevated; hyponatremia and hyperkalemia may also be present.

- 173.8. A 5-year-old girl presents with the complaint of a rash and knee pain. She has a palpable purpuric rash on both her lower extremities to her buttocks. Her knees are minimally swollen, with no increased warmth or limited range of motion. What is the most appropriate disposition for this patient?
- A. Admission for parenteral corticosteroids
  - B. Admission for plasmapheresis
  - C. Admission if there is severe renal involvement for immunoglobulin administration
  - D. Admission to the hospital for observation and intravenous doxycycline
  - E. Supportive treatment and peritoneal dialysis at home

**Answer: C.** Henoch-Schönlein purpura is an immunoglobulin A-mediated systemic vasculitis involving the small blood vessels supplying the skin, gastrointestinal tract, and joints. The hallmark of Henoch-Schönlein purpura is a palpable, purpuric, or petechial rash most prominent on the lower extremities, starting around the lateral malleoli and extending to the buttocks. Therapy for patients with severe renal involvement also includes intravenous immunoglobulins, although promising results have also been seen in patients with severe abdominal pain.

**173.9.** A 3-year-old girl presents with watery diarrhea and crampy abdominal pain. Her vital signs are blood pressure 130/80 mm Hg, heart rate 100 beats/min, respiratory rate 13 breaths per minute, and temperature 38.0°C (100.4°F). The diarrhea has been present for a number of days and has just turned bloody, which prompted the visit today. Laboratory assessment reveals hemoglobin, 6 g/dL, potassium, 6.1 mEq/L, blood urea nitrogen, 40 mg/dL, and creatinine, 2.5 mg/dL. Which of the following tests is most likely to aid in the diagnosis of this patient?

- A. Blood cultures
- B. Leukocytosis
- C. Peripheral smear with schistocytes
- D. Stool cultures
- E. Thrombocytosis

**Answer: C.** The patient has hemolytic-uremic syndrome, which is one of the most common causes of acute renal failure in children. It usually involves infants and children, with a mean age at presentation of 3 years, but is rare after 5 years of age. The peripheral blood smear shows microangiopathic changes such as tear-drop cells, helmet cells, microspherocytes, and burr cells.



## KEY CONCEPTS

- Causes of altered mental status in children include vascular events (eg, stroke, arteriovenous malformation with bleed), infection (eg, meningitis, sepsis, encephalitis), trauma, toxic ingestion, anatomic or structural abnormality (eg, intracranial mass or tumor), metabolic derangements, intussusception, or seizures, which may be subclinical.
- Altered mental status in children has a varied spectrum of clinical presentations, and may include any of the following: altered level of consciousness, excessive sleepiness, irritability, lethargy, and abnormal behavior.
- Signs and symptoms of bacterial meningitis vary by age and can include nonspecific manifestations in infants and young children, such as irritability and lethargy.
- Antibiotic therapy for the patient with suspected bacterial meningitis, should not be delayed by an LP. Initial antibiotic coverage should be broad and guided by the most likely pathogens in the patient's age group.
- A careful and detailed history is instrumental in determining whether an event was a seizure. If the event was a seizure, the history should delineate which type of seizure occurred (partial or generalized) and whether the clinical event fits into a known epilepsy syndrome.
- Status epilepticus constitutes a neurologic emergency that carries high morbidity and mortality rates. Initial treatment is typically with IV lorazepam, followed by fosphenytoin.
- A simple febrile seizure is generalized, lasts less than 15 minutes, and occurs in a neurologically and developmentally normal child between 6 months and 6 years of age.
- Children with simple febrile seizures do not require blood and urine testing, other than as needed for the evaluation of fever source. In immunized infants 6 to 18 months of age with a first-time simple febrile seizure, a lumbar puncture (LP) can be avoided if the child is not ill appearing, has returned to baseline, and there are no clinical signs of meningitis.
- The possibility of provoked seizures should be considered because many causes are treatable.
- Breath-holding spells occurs in children 6 months to 6 years of age, and are triggered by pain or emotional upset. After a trigger, the child becomes pale or cyanotic and may lose consciousness, sometimes with a brief period of clonic movements or opisthotonos.
- Most headaches in children have benign causes that usually can be diagnosed by a careful history and physical examination. Radiologic evaluation by CT, MRI, or both may be necessary to rule out secondary causes of headache such as intracranial hemorrhage, subarachnoid hemorrhage, brain tumor, or brain abscess.
- Warning signs of secondary headaches include sudden onset, occurrence with straining or exertion, association with neurologic symptoms, change in headache pattern, nocturnal awakening, and bilateral occipital headaches.
- In children, 40% of ataxia cases are caused by acute cerebellar ataxia.
- A toxicology screen is the test with the highest diagnostic yield for acute-onset ataxia in children.
- Approximately 45% to 60% of all childhood brain tumors arise in the brainstem or cerebellum and can be manifested with slowly progressive ataxia.
- The cause of vertigo with hearing loss is significantly different from that of vertigo with no hearing loss. This differentiation can be helpful in guiding the diagnostic evaluation.
- When assessing an infant or child with motor weakness, it is important to distinguish presentations consistent with upper motor neuron pathology from lower motor neuron processes.
- Strokes are less common in children than in adults. They represent a neurologic emergency and may be hemorrhagic or ischemic in nature. Imaging with CT and/or MR can help confirm the diagnosis of stroke. An important component of stroke management involves the prevention of secondary brain injury.
- Spinal cord compression is a medical emergency regardless of cause and requires prompt diagnosis and treatment. It may arise from trauma, infection and inflammation, or malignancy.
- The diagnosis of Guillain-Barré syndrome (GBS) is largely clinical, although LP may be helpful in confirming the diagnosis. Patients with GBS are at risk for respiratory compromise and should be admitted to the hospital for observation and supportive care.
- The diagnosis of infant botulism is largely clinical. If there is high clinical suspicion, treatment should be initiated promptly, without awaiting laboratory confirmation. Given the risk of respiratory compromise, infants with botulism should be admitted to the hospital for observation and supportive care.
- Diagnosis of myasthenia gravis in the ED may be confirmed with the Tensilon test. The disorder can often be treated on an outpatient basis, but patients with truncal involvement and concern for respiratory compromise should be admitted to the hospital for observation and supportive care.

## CHAPTER 174: QUESTIONS &amp; ANSWERS

**174.1.** Which of the following is the most common cause of neonatal meningitis?

- A. *Escherichia coli*
- B. Group B streptococci
- C. *Haemophilus influenzae*
- D. *Listeria monocytogenes*
- E. *Neisseria meningitidis*

**Answer: A.** *E. coli* is the most common cause of neonatal meningitis. The incidence of Group B streptococcal meningitis has declined with changes in prenatal screening, as well as with infant immunizations.

**174.2.** Which of the following clinical findings of bacterial meningitis is more common in newborns compared with infants and children?

- A. Hypothermia
- B. Neck ache
- C. Rash
- D. Shaking chills
- E. Tachycardia

**Answer: A.** Hypothermia is more commonly found in newborn infants with bacterial meningitis compared with older infants and children with a similar disease.

**174.3.** A 15-month-old child is seen with a history of one 10-minute tonic-clonic event, which was nonfocal and accompanied by a temperature of 39°C (102.2°F). Two hours after the event, the child is still unresponsive to external stimulation. Which of the following is the next step in the management of this child?

- A. Admit to the inpatient service for antibiotics after blood cultures are drawn.
- B. Admit to the inpatient service for continued observation.
- C. Carry out imaging by obtaining a magnetic resonance image (MRI) of the brain.
- D. Obtain a complete blood count (CBC) and urinalysis if the child does not improve in 1 hour.
- E. Order a lumbar puncture, complete blood count, and blood and urine cultures.

**Answer: E.** According to American Academy of Pediatrics recommendations, lumbar puncture is not necessary in children older than 12 to 18 months in whom the clinical findings are not suggestive of meningitis. Because this child has exhibited a prolonged postictal period, a more serious illness is suggestive.

- 174.4.** What is the appropriate treatment for a 12-year-old boy with a history of epilepsy who is brought from home by emergency medical services to the emergency department (ED), with multiple seizures within the 15 minutes. The child is still unconscious and seizing. Which of the following is the next step in the management of this child?
- A. Benzodiazepine; if seizures continue, fosphenytoin
  - B. Electroencephalography (EEG) and computed tomography (CT) scan of the head
  - C. Intubation using etomidate and vecuronium
  - D. Methohexital
  - E. Propofol infusion

**Answer: A.** If the airway cannot otherwise be maintained, there is respiratory failure, or there is evidence of increased intracranial pressure, the patient should be intubated. Do not paralyze the patient unless absolutely necessary. If needed, consider short-acting neuromuscular blockers such as succinylcholine and vecuronium. The three most commonly used agents to treat convulsive status epilepticus are benzodiazepines, fosphenytoin, phenytoin, and barbiturates. Methohexital actually lowers the seizure threshold. Propofol infusions should be used with great caution in children.

- 174.5.** A 3-year-old boy is seen for seizure-like activity at home. He has no prior history of epilepsy and no family history of seizures. His fever has been as high as 39° C (102.2° F), and his parents have been watching him at home. The history and physical examination are normal, and the child is fully immunized for age. Which of the following statements is not consistent with appropriate counseling of parents regarding their 3-year-old?
- A. Although acetaminophen may make him feel better, it will not prevent recurrence.
  - B. He is at high risk for developing epilepsy later in life.
  - C. It is safe for him to go home with the parents.
  - D. Seizures with fever are common in young children and do not lead to brain damage.
  - E. There is no need to start any antiepileptic medication.

**Answer: B.** In general, a child between 6 months and 5 years who has a normal neurologic examination and has had a brief seizure in the setting of fever can be assumed to have a simple febrile seizure. Future epilepsy is not predicted and is unlikely in children with simple febrile seizures.

- 174.6.** Which one of the following statements best describes the signs and symptoms associated with pediatric brain tumors?
- A. At the time of diagnosis, most patients with brain tumors have associated symptoms, such as nausea, vomiting, visual effects, problems with walking, weakness, changes in personality or school performance, or speech changes.
  - B. Headaches are never the first symptom of a pediatric brain tumor.
  - C. Most pediatric brain tumors are diagnosed within the first month after symptom onset.
  - D. Papilledema is one of the least common neurologic findings in children with brain tumors.

**Answer: A.** Of patients with brain tumors, most have some of the associated signs or symptoms noted in choice A. Headaches may be the first symptom of a pediatric brain tumor, although the frequency of this presentation increases with age. Papilledema is one of the more common neurologic findings, along with abnormal eye movements, ataxia, abnormal tendon reflexes, and abnormalities on the visual examination. CT scanning is usually not performed with the first sign of a headache unless clinically indicated.

- 174.7.** A 10-year-old boy is brought in by his mother for gait imbalance. He is alert and oriented to person, place, and time, and he has a negative drug or alcohol screen. He has a wide-based gait. What should be the next step in management?
- A. Admission and neurologic evaluation
  - B. Discharge home if CT scan is negative
  - C. Perform a lumbar puncture
  - D. Reassurance and primary care referral
  - E. Start sepsis evaluation

**Answer: A.** Most children with ataxia are seen in the first few days after onset, usually because of a refusal to walk, unsteadiness of arm movements, or the sudden development of a wide-based “drunken” gait. History should include recent infection, injury, inadvertent drug ingestion, or other family members with the same problem. Children with ataxia usually require admission for a complete evaluation. Consultation with a pediatric neurologist should be sought for patients in whom the cause of the ataxia is not evident on ED evaluation.

- 174.8.** A 14-year-old girl with a history of migraines presents to the ED with the complaint of being unable to move her left side following a severe right-sided headache. Which of the following statements best describes her management?
- A. Imaging, analgesics, and admit to the hospital because symptoms may last for days.
  - B. Immediate thrombolytics
  - C. Inpatient vasculitis evaluation is indicated.
  - D. She can be safely discharged home, and the symptoms will resolve in an hour.

**Answer: A.** Hemiplegic migraine is characterized by the sudden onset of hemiparesis or hemisensory loss followed by headache in the contralateral hemisphere. This type of migraine is seen more frequently in children than adults. Although symptoms usually last for hours or days, affected individuals are rarely left with permanent deficits.

- 174.9.** A mother brings in her 4-year-old son for periods of lip smacking that occur multiple times per week and last several minutes. During these episodes, he may turn his head to her when she calls, but he does not speak. You suspect which of the following condition?
- A. Complex partial seizure
  - B. Generalized seizure
  - C. Infantile spasm
  - D. Lennox-Gastaut syndrome
  - E. Simple partial seizure

**Answer: A.** In complex partial seizures, the patient has a change in level of awareness and may exhibit bizarre behaviors including staring, lip smacking, wandering, or picking at clothing. In simple partial seizures, the patient has no change in mentation. Lennox-Gastaut syndrome is characterized by mental retardation, multiple seizure types, and a classic EEG pattern of slow spike and wave. Infantile spasms manifest during the first year of life and consist of rapid, jackknife flexor or extensor spasms that appear in clusters.

## KEY CONCEPTS

- The growth plate is the weakest part of the bone and is more likely to separate before the adjacent tendon or ligament tears, thereby making sprains uncommon.
- Of supracondylar fractures, 95% are of the extension type. Displaced fractures are at risk for neurovascular injury and compartment syndrome; the anterior interosseous branch of the median nerve and the brachial artery are most commonly involved.
- Developmental dysplasia of the hip affects 1% of children; all children who are not yet walking should have a thorough hip evaluation, including Ortolani and Barlow testing.
- Transient synovitis presents between 3 and 9 years of age and usually involves the hip. It can be differentiated from septic arthritis and other causes of hip pain with a thorough physical examination and directed laboratory and radiographic evaluation.
- The peak incidence of septic arthritis is between 6 and 24 months of age. Patients presents with pain, fever, and decreased use of the involved limb. The knee is usually involved, followed by the hip. Inflammatory markers tend to be elevated, although they may be normal in young children with *Kingella kingae* infection. Blood and synovial fluid cultures are positive less than 50% of the time. *Staphylococcus aureus* is a frequent culprit. Treatment consists of joint drainage and empirical antibiotics (eg, nafcillin and ceftriaxone, with or without vancomycin).
- Examination of the hip is warranted in all patients with knee pain.
- Legg-Calvé-Perthes disease is an idiopathic avascular necrosis of the hip that has a peak presentation between 5 and 7 years of age. It is bilateral in 20% of cases.
- A slipped capital femoral epiphysis (SCFE) is a posteroinferior slippage of the proximal femoral epiphysis on the metaphysis. It is more common in boys than girls, more common with obesity, and bilateral in 80% of cases. It is best seen on a cross-table or frog leg lateral view radiograph; 90% are stable.
- Osgood-Schlatter disease is the most common form of apophysitis. The onset is insidious, and treatment is conservative and symptomatic. A sudden onset of apophyseal pain is more suggestive of an avulsion fracture.

## CHAPTER 175: QUESTIONS &amp; ANSWERS

- 175.1.** A 7-year-old boy presents with left elbow pain following a fall. He has a moderately swollen left elbow and holds his elbow in extension. He has pain and crepitus at the distal humerus, with anterior fullness. Which of the following statements regarding this patient's most likely injury is true?
- An anterior fat pad may be normal.
  - An elbow flexion mechanism is likely.
  - Brachial artery injuries occur in less than one-third of cases.
  - The external epicondyle should be ossified on a radiograph.
  - The most commonly injured nerve is the radial nerve.

**Answer: A.** Supracondylar humerus fractures involve an extension mechanism 95% of the time. On plain films, an anterior fat pad may be normal as long as it is not bulging or sail-shaped. A posterior fat pad is never normal and warrants further imaging. The CRITOE mnemonic is useful to recollect that the external (lateral) epicondyle is the last elbow ossification center to ossify (age 11 years). Neurovascular injuries are common, with brachial artery injuries in up to 40% of cases. The median nerve is most commonly injured.

- 175.2.** Which of the following statements regarding nursemaid's elbow is true?
- After reduction, normal use should be observed by 4 to 6 hours.
  - Peak incidence is between 6 and 8 years of age.
  - Pronation is the reduction technique of choice.
  - Radiographs are necessary before reduction.
  - Swelling and ecchymosis are common.

**Answer: C.** Pronation is associated with success rates equal to those for supination and is associated with less pain. Normal use should be observed within approximately 10 to 30 minutes. Radiography is not indicated unless there is swelling, erythema, ecchymosis, or deformity. The peak incidence is age 2 or 3 years, with a slight female predominance.

- 175.3.** A 21-month-old presents after a fall from standing. Since the fall, he has refused to walk or put weight on his left leg but is able to crawl without difficulty. Anteroposterior (AP) and lateral views of the left lower extremity are normal. Which of the following statements regarding this patient's most likely injury is true?
- If not seen on routine radiographs, internal oblique radiographs may reveal the injury.
  - It requires a high-energy mechanism of injury.
  - Nonaccidental trauma should be considered in all children with this injury.
  - Peak incidence is between 6 and 8 months of age.
  - Treatment consists of a below-knee walking cast and immobilization.

**Answer: A.** Toddler's fractures are oblique nondisplaced fractures caused by low-energy torsional forces applied to the porous bone of infants and young children. The peak age of presentation is between 9 and 36 months of age. The mechanism of injury can be as mild as the child's twisting on the leg while walking or a fall from an insignificant height. AP and lateral radiographs may reveal a spiral or oblique fracture extending downward and medially through the distal third of the tibia. An internal oblique radiograph is helpful if evidence of fracture is absent on the AP or lateral view. Treatment of a toddler's fracture consists of a long leg cast for approximately 3 weeks.

- 175.4.** A 14-year-old obese male presents with progressively worsening left knee pain. On examination, he has full range of motion of the knee but is unable to move his left hip due to severe pain and is unable to bear weight. This patient's most likely injury would cause which of the following findings on routine radiographs?
- Fragmentation of the femoral head
  - Inferiorly and posteriorly displaced femoral epiphysis relative to the metaphysis on a cross-table lateral view of the hip
  - Inferiorly and posteriorly displaced femoral epiphysis relative to the metaphysis on a frog leg view of the hip
  - Medial joint space widening on hip or pelvis radiographs

**Answer: B.** This patient's history is consistent with an unstable slipped capital femoral epiphysis (SCFE). The diagnosis of SCFE is made with AP and lateral radiographs of both hips. With stable slippage, AP and frog leg lateral pelvic radiographs should be obtained. When an unstable slip or a minimal slip is suspected, a cross-table radiograph replaces the frog leg lateral view. Fragmentation of the femoral head is seen in Legg-Calve-Perthes disease. Widening of the medial joint space is suggestive of a joint effusion and can be seen in Legg-Calve-Perthes disease, transient synovitis, or septic arthritis.

- 175.5. Which of the following statements regarding apophyseal disorders is true?
- A. The age of onset tends to be younger in females than in males.
  - B. The first-line treatment is casting and immobilization.
  - C. They are extremely rare.
  - D. They only occur in mature skeletons.
  - E. They usually occur in adolescents older than 16 years old.

**Answer: A.** Apophysitis is unique to patients with skeletal immaturity and involves inflammation of the cartilaginous structure that serves as a site for insertion of tendons on the growing bone. Growth contributes to the development of apophysitis; females mature at a younger age than males and are affected earlier in life. Apophysitis is common and is estimated to occur in 18% of pediatric patients. Children between 8 and 15 years of age are most frequently affected, with different apophyseal centers affected at different ages.

## KEY CONCEPTS

- Recent legislative efforts have begun to remove regulatory hurdles in closing the therapeutic gap between adult and pediatric patients.
- Awareness of differences in pediatric pharmacokinetics and specific drug toxicities is of critical significance for the safe and effective use of medications in children.
- Avoid prescription and OTC cough and cold medications in children younger than 6 years because these agents have limited efficacy data and may cause harm.
- Counsel parents about the management of fever and appropriate indications for and proper use of antipyretics.
- Perform a risk assessment prior to prescribing opioid analgesics and, when indicated, use safe prescribing practices and monitor for signs of prescription drug abuse.
- A multifaceted approach using clinical support systems and readily available reference tools are essential for the delivery of optimal emergent pediatric care.

## CHAPTER 176: QUESTIONS &amp; ANSWERS

**176.1.** A 15-year-old girl presents to the emergency department (ED) for arm pain with an old thumb spica splint and states that she ran out of her oxycodone prescription for a possible fracture and has been unable to follow-up with her orthopedist. Vital signs, examination, and radiographs are unremarkable. Which of the following is a best practice option for ED opioid prescribing?

- A. Avoiding confusion by minimizing adjunct medication options
- B. Consulting state prescription drug monitoring programs and prior medical and pharmacy records
- C. Encouraging the parents of adolescents to maintain a central location in the house to store old and unused prescriptions
- D. Working independently of outpatient providers to avoid undertreating chronic pain

**Answer: B.** Perform a risk assessment prior to prescribing opioid analgesics and, when indicated, use safe prescribing practices and monitor for signs of prescription drug abuse. Although parents should help with an adolescent's medications, unused prescriptions should be properly disposed of instead of maintained in the household, where they will be susceptible to future unintended misuse. Chronic pain management requires a multifaceted approach with emergency providers who are aware of an individual's pain management contract so as not to contribute to overuse. Adjunct medications such as nonsteroidal antiinflammatory drugs or neuroactive agents can help reduce overall opioid requirements. Prescription drug monitoring programs should be used, when possible, to limit the overprescribing of opioids from the emergency department.

- 176.2.** Which of the following factors contributes to the relatively fewer number of pediatric-specific drugs and formulations compared to the adult population?
- A. Ethical and institutional considerations of pediatric trials
  - B. FDA rules prohibiting extrapolation of adult data to pediatric labeling
  - C. Inability to use drugs approved for adults that are off label for children
  - D. Lack of federal mandate that manufacturers conduct clinical trials in children for drugs under development that have the potential for pediatric use

**Answer: A.** Recent legislative efforts have begun to remove regulatory hurdles in closing the therapeutic gap between adult and pediatric patients. The Pediatric Research Equity Act (PREA) in 2003 mandated that manufacturers conduct clinical trials in children for drugs under development that have the potential for pediatric use. The FDA Pediatric Labeling Rule in 1994 allowed for pediatric labeling based on extrapolation of adult data if the course of disease was similar in both populations. There are high rates of off-label use for many drugs used in children. These federal regulations and more were put in place to encourage pediatric research, despite the ethical and institutional considerations of pediatric trials, which can prove more difficult to surmount than in the adult population.

**176.3.** A healthy, fully vaccinated 11-month old male infant presents to your department for evaluation of a fever of 38.4°C (101.1°F) this morning that responded to a dose of acetaminophen. The physical examination reveals a well-appearing, afebrile infant with clear lungs. The patient has an unremarkable evaluation and, during the discharge process, his parents ask for advice regarding fever management. Which of the following statements is correct?

- A. Aspirin should not be used in children younger than 15 years because of the risk of Reye's syndrome
- B. Cool water baths and creams should be used to supplement antipyretics, even if they cause some discomfort to the patient.
- C. Ibuprofen cannot be used in this age group because of ongoing renal development.
- D. Over-the-counter (OTC) antipyretics are standardized, contain similar products and formulations, and are thus interchangeable.

**Answer: A.** Counsel parents and caregivers about the management of fever and appropriate indications for and proper use of antipyretics. There is no need to cause discomfort with external cooling methods for fever control. Ibuprofen should not be used in children younger than 6 months because of ongoing renal development. The formulations and dosing of OTC antipyretics are varied and cannot be used interchangeably. The correct answer is A because of the risk of Reye's syndrome with aspirin administration during a viral illness in children younger than 15 years.



**176.4.** Which of the following statements regarding pediatric pharmacokinetics is correct?

- A.** A thinner stratum corneum and increased body surface area contribute to a greater risk for systemic toxicity from dermally administered drugs.
- B.** An immature blood-brain barrier can result in kernicterus after ceftriaxone administration in neonates, resulting in increased bilirubin production.
- C.** Because of minimal differences in the volume of distribution and renal development, weight-based dosing of gentamicin without attention to age is sufficient.
- D.** Quicker gastric emptying and decreased gastric pH in neonates increase systemic absorption of enterally administered medications.

**Answer: A.** Awareness of differences in pediatric pharmacokinetics and specific drug toxicities is of critical significance for the safe and effective use of medications in children. The dosing of gentamicin needs to account for age-based differences in renal development in addition to weight-based differences in distribution volume. Decreased gastric emptying times and an increased pH can prolong exposure to medications before they pass the pylorus. An immature blood-brain barrier can result in kernicterus from bilirubin displacement by ceftriaxone. The correct answer is that a thinner stratum corneum and increased body surface area contribute to a greater risk for systemic toxicity from dermally administered drugs.

**176.5.** Which of the following steps can be taken to reduce pediatric dosing errors?

- A.** Adoption of electronic health records to decrease weight-based dosing errors
- B.** Calculation of weight-based dosing for all emergent medications administered in code situations as opposed to using a validated quick reference guide
- C.** Limiting hospital pharmacist presence in the emergency department to avoid delays in bedside care
- D.** Medication reconciliation should occur with just the patient present to limit primary caregiver influence

**Answer: A.** A multifaceted approach using clinical support systems and readily available reference tools are essential for the delivery of optimal emergent pediatric care. Caregivers are an integral part of medication reconciliation. ED pharmacists have been proven to increase departmental accuracy in pediatric medication management. Validated quick reference guides for code drug administration have been shown to decrease errors and improve efficiency.

## KEY CONCEPTS

- Emergency department (ED) evaluation of pediatric sexual assault should focus on time-dependent medical treatment and evidence collection. Ultimate determination of the likelihood of sexual assault can be deferred pending outpatient resources including forensic interview.
- A normal examination neither confirms nor excludes the possibility of abuse, but patients may be reassured that their body is normal and healthy.
- A genital examination should not be forced on a child.
- Likelihood of obtaining forensic evidence decreases with time from assault. Evidence collection may be performed up to 3 to 7 days after sexual assault, depending on jurisdiction. After 24 hours, non-body specimens (such as, undergarments) are most likely to have evidence.
- Emergency contraception should be offered to pubertal females up to 120 hours after sexual assault.
- Prophylactic or empirical treatment for gonorrhea, chlamydia, and trichomonas are not recommended for pre-pubertal children. Treatment should be deferred until infection is confirmed.
- When an investigation for sexual abuse is ongoing, caregivers should be counselled to provide a believing, supportive environment if their child reports abuse or has questions, but caregivers should not attempt to conduct their own interview of the child.

## CHAPTER 177: QUESTIONS &amp; ANSWERS

**177.1.** A 12 month-old girl is referred to the emergency department (ED) because her daycare noticed that she cried whenever she is picked up and crepitus in the left side of the chest. They deny any witnessed trauma in the daycare facility. The mother arrives and appears concerned. On physical examination, you find some circular contusions on the inner aspects of both her upper arms. The mother states this occurred from a fall a week ago. Which of the following should be the next step in the patient's management?

- A. Conduct a skeletal survey, and call child protective services (CPS) as a mandated reporter.
- B. Discharge the patient if a thorough physical examination is normal.
- C. Determine whether the arm contusions are of the same age.
- D. Perform a dedicated retinal examination to determine if the child has retinal hemorrhages and, if she does, perform a head computed tomography (CT) scan.
- E. Perform a humerus x-ray to determine if there is a humerus fracture.

**Answer: A.** Contusions on the inner aspect of the upper arm are atypical injuries in light of the mother's claim of a fall for the child. This pattern of injury is often related to being held tightly around the arm. Chest wall pain in a child could indicate a rib fracture. Chest x-ray is insensitive for rib fractures, which are very uncommon at this age unless caused by inflicted trauma. This should raise your suspicion of child physical abuse. In general, children younger than 2 or 3 years old with suspected inflicted injuries should be evaluated with a skeletal survey.

**177.2.** In a 12 month-old, which of the following fractures are very concerning for abuse?

- A. Metaphyseal fracture of the radius
- B. Occipital skull fracture
- C. Spiral fracture of the tibia (toddler's fracture)
- D. Both A and B
- E. All of the above

**Answer: D.** A toddler's fracture, also referred to as a *CAST* (child hood accidental spiral tibial) fracture, occurs when there is a twisting injury to the tibia as the child falls on it. In toddlers, this is usually an accidental injury. In particular, metaphyseal fractures, rib fractures, scapula fractures, and certain types of skull fractures should raise concern about inflicted trauma.

**177.3.** An 8-year-old girl presents after sexual assault in which she reports penile-vaginal penetration 8 hours prior to presentation. Which of the following is not indicated?

- A. Consideration of human immunodeficiency virus (HIV) post-exposure prophylaxis (PEP) based on local disease prevalence, other risk factors, and patient preferences
- B. Genital examination

- C. Prophylactic/empirical treatment for gonorrhea and chlamydia
- D. Report to child protective services (CPS) and/or law enforcement
- E. Testing for gonorrhea and chlamydia

**Answer: C.** Prophylactic/empirical treatment for gonorrhea and chlamydia is not recommended in the emergency department (ED) for pre-pubertal children because the forensic significance of these diseases far outweighs their clinical significance. Gonorrhea and chlamydia very rarely ascend to the upper genital tract in pre-pubertal children, and the risk of long-term complications of deferred treatment is therefore low.

**177.4.** Which of the following is not a finding suggestive of an underlying medical condition?

- A. Blue sclera, brown discolored teeth, and frequent fractures
- B. Bruises on both buttocks and flanks after jumping off the bed
- C. Dark discoloration in the shape of a hand after making lemonade in the sun
- D. Dark discoloration over lower spine present since first week of life
- E. Osteopenia in a premature infant

**Answer: B.** Non-inflicted bruises are usually unilateral, occurring on the side where a fall or collision with a solid object has occurred. Bruises on the buttocks and flank must be explained by the mechanism of injury and are unusual in non-inflicted trauma. Phytophotodermatitis may be mistaken for bruises. This is a condition that develops on sun-exposed areas of the body that have been in contact with certain fruits or juices, such as lime or lemon juice. Premature infants may experience osteopenia of prematurity. Osteogenesis imperfecta, a brittle bone disease, is associated with other clinical findings, such as blue sclerae and brown discoloration of the teeth (dentinogenesis imperfecta). Dermal melanocytosis (Mongolian spots) are bluish discolorations that are seen normally over the buttocks and lower spine in children with darker complexions.

**177.5.** An otherwise healthy 3-month-old boy is brought to the emergency department (ED) in a deep coma. Caregivers report that he was completely normal until 30 minutes prior to arrival when he suddenly seized. He is obviously ill with a pediatric Glasgow Coma Score (GCS) of 3. A head computed tomography (CT) scan shows bilateral subdural hematomas. Which other testing is *not* indicated to determine the likelihood of abusive injury?

- A. Aspartate transaminase (AST)/alanine transaminase (ALT) with abdominal CT if these are abnormal
- B. Dedicated retinal examination by an ophthalmologist
- C. Determine whether there are other children in the home
- D. Skeletal survey when the child is clinically stable
- E. Testing for osteogenesis imperfecta

**Answer: E.** Osteogenesis imperfecta is an important consideration in children when the concern for abuse is based exclusively on bony injuries (fractures). It does not cause traumatic brain injury. All Children with concern for abusive head trauma should have a dedicated retinal examination to determine whether there are retinal hemorrhages or other retinal findings of abuse. Testing for abdominal injuries or fractures can identify additional abusive injuries. Young children (<24 months old) who share a home with an abused child are at high risk for abuse, especially twins.

- 177.6. In a 2-week-old infant that is not yet crawling, which of the following is most highly concerning for abuse?
- A. Clavicle fracture with callous
  - B. Lateral rib fracture with obvious callous
  - C. Parietal skull fracture without callous
  - D. Torn lingual frenulum with scant bleeding
  - E. All of the above

**Answer: D.** Lingual frenulum tears are very concerning for abuse in pre-mobile infants. These injuries heal quickly, and the presence of bleeding excludes the possibility of birth injury. Several self-limited injuries can result from the birth process, even in deliveries that are not recognized as particularly traumatic. These injuries can be clinically subtle and are not uncommonly missed in the newborn nursery. Rib fractures are uncommonly seen from birth and are more common in larger infants or difficult deliveries. The presence of obvious callous on the rib fractures is consistent with a fracture that is at least 7 to 14 days old. Clavicle and skull fractures are not uncommon parturitional injuries. Unlike other fractures, skull fractures do not develop callous and their age cannot be estimated.

- 177.7. Which of the following can be used to estimate the age of an injury?
- A. Color can be used to estimate the age of a bruise within 12 to 24 hours.
  - B. Density on computed tomography (CT) scan can be used to estimate the age of subdural hematomas within 1 to 2 days.
  - C. Intensity on magnetic resonance imaging (MRI) can be used to estimate the age of subdural hematomas within 1 to 2 days.
  - D. The presence of periosteal reaction can be used to estimate the age of a fracture within 1 to 2 weeks.

**Answer: D.** Several studies have demonstrated that periosteal reaction and callous begin to become visible after 1 to 2 weeks. Conversely, neither color of bruising nor appearance of subdural hematomas on CT scan or MRI has been shown to reliably correlate with timing. The age of retinal hemorrhages cannot be precisely determined by their appearance.

- 177.8. Which injury is most concerning in light of the reported mechanism?
- A. A 6-month-old with a linear, parietal skull fracture after a 3-foot fall from a bed to a hardwood floor
  - B. A 13-month-old, unrestrained passenger in a high-speed motor vehicle collision who has a large subdural hematoma and a few retinal hemorrhages around the optic nerve
  - C. A 27-month-old who with a small bowel perforation and pancreatic laceration after a fall down eight steps
  - D. An 18-month-old who presents with a spiral tibia fracture and no history of trauma
  - E. A 10-year-old who presents with a spiral femur fracture after a crash while skiing

**Answer: C.** Intra-abdominal injuries of any kind are uncommon after short falls or stairway falls. Hollow-viscus ruptures and pancreatic injuries are particularly concerning for abuse. Although spiral fractures have been thought to be particularly concerning for abuse, more recent data has not supported this. Spiral tibia fractures (toddler's fractures) are common among children learning to walk, and spiral femur fractures are plausible from injuries if there is sufficient energy and a torquing mechanism. Too numerous to count retinal hemorrhages in multiple layers and throughout the retina are relatively specific for abusive head trauma, but severe non-inflicted head injuries can also result in retinal hemorrhages that are few, and localized to the posterior retina. Linear, parietal skull fractures can result from relatively minor trauma.

- 177.9. A 13-month-old girl with an abusive femur fracture and a small abdominal bruise is found to have AST 475 and ALT 300. The next most appropriate step to identify an abusive abdominal injury is:
- A. Abdominal computed tomography (CT) scan with intravenous (IV) contrast
  - B. Amylase, lipase, urinalysis, and white blood cell count
  - C. Focused abdominal sonography in trauma (FAST) ultrasound
  - D. Formal abdominal ultrasound
  - E. Repeat aspartate transaminase (AST)/ alanine transaminase (ALT) in 6 to 12 hours to determine whether values are worsening

**Answer: A.** Abusive abdominal injuries can be clinically subtle, and even small injuries that are clinically self-limited can have important forensic significance. Children with severe abusive injuries should have hepatic transaminase testing to identify occult abdominal injuries and those with clinical signs of abdominal injury or with elevated transaminases (>80 IU/L) should undergo abdominal CT scan with IV contrast. Other laboratory tests and ultrasound are relatively insensitive for traumatic intra-abdominal injuries. Whether or not there is an injury, elevated hepatic transaminases almost always normalize quickly over time.

- 177.10. A 10-year-old, pre-pubertal girl presents to the emergency department (ED) at midnight after reporting to her parents that she was sexually abused 2 weeks ago while at summer camp. The patient is tired and irritable at the time of presentation. Which of the following are indicated in the ED?
- A. Human immunodeficiency virus (HIV) post-exposure prophylaxis (PEP)
  - B. Obtain a detailed history of the assault including the time, place and circumstances of all sexual contact
  - C. Pregnancy prophylaxis with levonorgestrel (Plan B)
  - D. Report to child protective services (CPS)
  - E. Urgent genital examination

**Answer: D.** For sexual abuse that has occurred more than 1 week prior to presentation, ED management should include fulfilling the mandate to report to CPS and ensuring that the child has a safe place for discharge. A genital examination may be attempted in a cooperative patient and can assist in assuring the child that they are normal and healthy, but the examination should not be forced on the child if they are reluctant; and it is unlikely to identify transient evidence of sexual contact at this time. The detailed forensic interview should be conducted by a trained interviewer and may be deferred until the patient is rested. Plan B and HIV PEP are unlikely to be effective 2 weeks after the assault, and pregnancy prophylaxis is not indicated for pre-pubertal children.

## KEY CONCEPTS

**Ectopic Pregnancy**

- An ectopic pregnancy can masquerade as a threatened miscarriage in the early stages of pregnancy and should always be considered in the differential diagnosis.
- Because the history and physical examination of the patient with ectopic pregnancy are insensitive and nonspecific, pelvic ultrasonography and determination of serum hCG levels are essential to locate the pregnancy in any patient who has abdominal pain or vaginal bleeding and a positive pregnancy test result.

**Bleeding in Late Pregnancy**

- Bleeding during the second trimester (14–24 weeks) is not benign and is associated with a 33% risk of fetal loss. Management is supportive and expectant because fetal rescue is impossible at this level of fetal immaturity.
- The major conditions associated with vaginal bleeding in the second half of pregnancy include abruptio placentae and placenta previa. Patient history, physical examination, and results of ultrasonography can be used to distinguish them.
- All patients with painless, second-trimester vaginal bleeding should be assumed to have placenta previa until proven otherwise. Digital or instrumental probing of the cervix should be avoided until the diagnosis has been excluded via ultrasound.
- Abruptio placentae has consists of a wide spectrum of severity of symptoms and risk. Up to 20% of women will have no pain or vaginal bleeding. Assessment is generally based on clinical features, coagulation parameters, and signs of fetal distress.

**Hypertension in Pregnancy**

- Gestational hypertension occurs during pregnancy, resolves during the postpartum period, and is recognized by a new blood pressure reading of 140/90 mm Hg or higher.
- Preeclampsia is gestational hypertension with proteinuria (>300 mg/24 hr); eclampsia is the occurrence of seizures in the patient with signs of preeclampsia.
- The HELLP syndrome is a particularly severe form of preeclampsia characterized by **h**emolysis, **e**levated **l**iver enzyme levels (ALT and AST > 70U/L), and **l**ow **p**latelet count (<100,000/mL).
- Because progression of preeclampsia to eclampsia is unpredictable and can occur rapidly, blood pressure control in the pregnant patient is of utmost importance.

**Amniotic Fluid Embolism**

- Amniotic fluid embolus should be suspected during the second or third trimester of pregnancy, particularly in the setting of uterine manipulation or contraction, when a patient experiences sudden hypotension, hypoxia, and coagulopathy.
- Treatment of amniotic fluid embolus consists of support of oxygenation and ventilation, aggressive fluid resuscitation, inotropic cardiovascular support, and anticipation and management of consumptive coagulopathy.

**Rh Immunization**

- Rh immunization occurs when an Rh-negative woman is exposed to Rh-positive fetal blood. To prevent this, a dose of 50 µg of Rh immune globulin can be used if the patient is at less than 12 weeks of gestation. After 12 weeks, a 300-µg dose should be given.

**Abdominal Pain in Pregnancy**

- Appendicitis is the most common surgical emergency in pregnancy. Clinical presentations may be atypical, leading to a misdiagnosis rate of 30% to 35% in pregnant patients. Right lower quadrant pain is the most common finding, especially early in pregnancy. Ultrasound, CT, and MRI are useful for the diagnosis.
- Cholelithiasis presents with similar symptoms to those in nonpregnant women and is similarly diagnosed through ultrasound. Surgery, if required, is optimally done during the second trimester.

- During pregnancy, albumin levels decrease while alkaline phosphatase levels may increase up to double; amylase levels may also be slightly elevated.
- Hepatitis is the most common cause of liver disease in pregnancy; the increased incidence of hepatitis E has increased maternal mortality and rate of fetal loss.
- Acute fatty liver of pregnancy is a rare disorder of the third trimester that can result in hepatic failure, complicated labor, and fetal mortality. Coagulopathy, jaundice, seizures, DIC, and hepatic encephalopathy may also result.
- Intrahepatic cholestasis of pregnancy typically presents with generalized pruritus and mild jaundice. Resolution occurs with delivery. Women are at increased risk for preterm delivery, meconium passage, and intrauterine fetal demise.

**Nausea and Vomiting in Pregnancy**

- Nausea and vomiting in pregnancy is common and may be treated with conservatively with diet modification and avoidance of environmental triggers. If conservative measures fail, Diclegis, a delayed-release combination of doxylamine, 10 mg, and pyridoxine (vitamin B<sub>6</sub>), 10 mg, is the first-line pharmacologic agent for the treatment of nausea and vomiting in pregnancy.
- Hyperemesis gravidarum is defined as nausea and vomiting that cause starvation metabolism, weight loss, dehydration, and prolonged ketonemia and ketonuria. Initial management involves rehydration with IV fluids, antiemetics, and demonstration of ability to take oral hydration.

**Thromboembolism in Pregnancy**

- Thromboembolic disease accounts for almost 20% of obstetric mortality, making it the leading cause of death in pregnancy.
- Doppler ultrasonography is the first-line test for the diagnosis of DVT. CT angiography and lung scintigraphy are used for the diagnosis of PE.
- Low-molecular-weight heparin is preferred for anticoagulation.

**Vaginal and Urinary Tract Infections**

- Asymptomatic bacteriuria in pregnancy predisposes the patient to the development of symptomatic lower and upper tract genitourinary infections. Because up to 30% of women who have asymptomatic bacteriuria will have pyelonephritis if they are untreated, treatment of bacteriuria is cost-effective and important.
- Treatment of bacterial vaginosis is directed toward symptomatic relief for the patient and does not necessarily improve fetal outcomes. Management includes a 7-day course of metronidazole or 7-day course of clindamycin.
- For the treatment of vulvovaginal candidiasis, oral azoles are contraindicated in pregnancy because of an association with adverse fetal outcomes. Treatment with vaginal azoles for 7 days during pregnancy is considered safe, with an estimated 85% to 100% cure rate.
- Of patients who have trichomoniasis, 50% are asymptomatic. Diagnosis is made by direct visualization of protozoans on wet mount. The recommended treatment is metronidazole, a one-time dose of 2 g, for symptomatic patients only.
- Regarding the treatment of sexually transmitted diseases, in general, the tetracyclines and quinolones are contraindicated in pregnant patients. Treatment of genital tract infections may be important for preventing preterm labor and decreasing transmission to the infant.
- *Chlamydia trachomatis* infection is the most common sexually transmitted disease in the United States and worldwide. Treatment during pregnancy or breast-feeding is azithromycin (single 1-g dose); a 7-day course of amoxicillin is an acceptable alternative.



## KEY CONCEPTS—cont'd

- Women who have genital herpes during the third trimester have a 30% to 50% increased risk of transmission compared with women with herpes simplex virus (HSV) infection in the first trimester (1%).
  - Suppressive therapy can reduce the need for cesarean section in women whose first clinical episode of genital HSV occurred during pregnancy.
  - Gonococcal arthritis is the most common manifestation of gonococcal dissemination. Diagnosis and treatment of gonococcal infections are unchanged by pregnancy; treatment includes cephalosporins or azithromycin.
  - PID is very rare in pregnancy and does not occur after the first trimester. Given the risk of endometrial infection in pregnancy and the need to consider other diagnoses, pregnant patients who have suspected PID require hospitalization and IV antibiotics.
  - Chorioamnionitis is diagnosed by the findings of fever, maternal and fetal tachycardia, and uterine tenderness in a patient past 16 weeks of pregnancy. Patients are usually treated with IV ampicillin and gentamicin.
- Thyroid Disease**
- During pregnancy, the thyroid gland increases in size, requires more iodine, and produces more thyroid hormone than in the nonpregnant state.
  - Hyperthyroidism, characterized by suppressed TSH levels and elevated  $T_4$  and/or  $T_3$  levels occurs in only 0.1% to 0.4% of all pregnancies. Graves' disease and hCG-mediated hyperthyroidism are the most common causes.
  - When US women are diagnosed with hypothyroidism, the most common cause is Hashimoto's (autoimmune) thyroiditis.
  - Postpartum thyroiditis is characterized by transient hyperthyroidism and/or hypothyroidism in the postpartum period. Approximately 25% of these women develop permanent hypothyroidism in the subsequent 10 years.
  - Hyperthyroidism may be associated with a hydatidiform mole and usually resolves with evacuation of the mole.
  - The diagnosis of hyperthyroidism is confirmed by a low ( $<0.1$  mU/L or undetectable ( $<0.01$  mU/L) serum TSH level and levels of free  $T_3$  and  $T_4$  that exceed the normal range for pregnancy.
  - Confirmation of hypothyroidism is based on an elevated serum TSH level, relying on trimester-specific TSH reference ranges.
  - Propylthiouracil (PTU) is the preferred treatment of hyperthyroidism in the United States. For thyroid storm, dexamethasone and beta blockers are added, with the patient under observation in the intensive care unit.
  - Hypothyroidism in pregnancy is managed with levothyroxine supplementation (2  $\mu$ g/kg/day).

## CHAPTER 178: QUESTIONS & ANSWERS

- 178.1.** An 18-year-old G1P0 at 8 weeks of gestation presents with abdominal pain and vaginal bleeding for 1 day. Her serum human chorionic gonadotropin (hCG) level is 3,700 IU/L. Transvaginal ultrasonography does not reveal an intrauterine pregnancy (IUP) or mass. The pelvic examination is remarkable for a closed cervical os and a small amount of blood. Which of the following should be the next step?
- A. Coagulation panel
  - B. Gynecologic consultation
  - C. RhoGAM, 300  $\mu$ g intramuscularly
  - D. Repeat hCG in 2 days
  - E. Serum progesterone level

**Answer: A.** Ultrasonographic detection of an IUP is likely at hCG levels higher than 1500 to 2000 IU/L. A negative ultrasound, with an hCG level of 3700 IU/L, is concerning for an ectopic pregnancy or miscarriage.  $\beta$ -hCG levels should peak at the 7- to 10-week range, with mean values of 50,000 IU/L. A persistently low hCG level is even more suspicious for ectopic pregnancy, and gynecologic consultation is warranted.

- 178.2.** A 36-year-old G3P2 presents with painless vaginal bleeding during the past hour. She is at 33 weeks of gestation, and her pregnancy has been uncomplicated. Her bleeding lasted approximately 20 minutes. Appropriate management includes all of the following except which one?
- A. Baseline hemoglobin level and platelet count
  - B. Immediate complete pelvic examination
  - C. Immediate obstetric consultation
  - D. Intravenous fluid resuscitation
  - E. Transvaginal ultrasound

**Answer: B.** Painless late pregnancy bleeding is placenta previa until proven otherwise. Digital or instrumental probing of the cervix should be avoided until the diagnosis is excluded via ultrasound. An injudicious vaginal examination can precipitate severe hemorrhage in the patient with an asymptomatic or minimally symptomatic placenta previa.

- 178.3.** In pregnancy, treatment is indicated in each of the following sexually transmitted diseases except which one?
- A. *Chlamydia trachomatis*
  - B. Herpes simplex virus
  - C. *Neisseria gonorrhoeae*
  - D. Pelvic inflammatory disease (PID)
  - E. *Trichomonas vaginalis*

**Answer: E.** Although trichomoniasis has been associated with increased prematurity, treatment with metronidazole has not been shown to improve fetal outcomes, so emergency clinicians should counsel patients and consider deferring treatment in asymptomatic pregnant women until after 37 weeks' gestation.

- 178.4.** A 28-year-old G3P0 at 34 weeks of gestation presents with new-onset seizures. The patient has multiple seizures in the emergency department (ED) and is noted to be hypertensive at a blood pressure of 164/87 mm Hg. Which of the following should be administered next?
- A. Benzodiazepines
  - B. Calcium gluconate
  - C. Labetalol
  - D. Magnesium sulfate
  - E. Pralidoxime

**Answer: D.** Magnesium sulfate has little antihypertensive effect but is the most effective anticonvulsant, preventing recurrent seizures while maintaining uterine and fetal blood flow. A loading dose of 4 g intravenous (IV) magnesium, followed by 2 g IV/hr, is recommended.



**178.5.** A 36-year-old G5P4 at 8 weeks of gestation presents to the ED with painless vaginal bleeding. Ultrasonography shows products of conception in the uterus. The pelvic examination shows a dilated cervix and a moderate amount of blood in the vaginal vault. Which of the following is appropriate management?

- A. All of these
- B. Expectant management
- C. Medical management with misoprostol
- D. None of these
- E. Surgical evacuation

**Answer: A.** All of these are appropriate management options for an incomplete miscarriage.

**178.6.** Which of these is the most commonly observed surgical emergency in pregnancy?

- A. Abruptio placentae
- B. Appendicitis
- C. Cholecystitis
- D. Ovarian torsion
- E. Ruptured peptic ulcer

**Answer: B.** Appendicitis is the most common surgical emergency in pregnancy. Clinical presentations may be atypical, particularly during the second half of pregnancy.

**178.7.** For the treatment of nausea and vomiting in pregnancy, which of the following has been found to have some associated risk of fetal abnormalities?

- A. Diclegis (delayed-release combination of doxylamine and pyridoxine)
- B. Ginger
- C. Metoclopramide
- D. Ondansetron
- E. Promethazine

**Answer: D.** Ondansetron has been shown in studies to be linked with fetal cardiac abnormalities, as well as cleft lip and palate. Diclegis is first-line pharmacologic treatment of nausea and vomiting in pregnancy; metoclopramide and promethazine are alternatives if it fails. Ginger, a nonpharmacologic treatment, has been shown to be safe and effective at a dose of 250 mg qid.

**178.8.** Which of the following is not considered a normal physiologic change in pregnancy?

- A. Decreased albumin level
- B. Increased D-dimer level
- C. Increased serum amylase level
- D. Increased serum bilirubin level
- E. Increased WBC count

**Answer: D.** Bilirubin, transaminase, and lactate dehydrogenase levels and prothrombin times are unchanged from the nonpregnant state. Albumin levels decrease secondary to an increase in maternal circulating plasma volume. Alkaline phosphatase levels may be up to double the nonpregnant values, and amylase levels may also be slightly elevated. The D-dimer level can be substantially elevated, even in normal pregnancy.

## KEY CONCEPTS

- The physiologic demands of pregnancy may cause previously occult medical conditions to become apparent and known problems to deteriorate rapidly.
- The physiologic adjustments of pregnancy alter the normal ranges for certain laboratory values. The adjusted values need to be considered in the interpretation of results.
- The possibility of pregnancy should be considered in the differential diagnosis of certain conditions, including new-onset seizures or status epilepticus (eclampsia), glucose intolerance (GDM), persistent vomiting (hyperemesis gravidarum), and thyroid disorders.
- The immunosuppressive effects of pregnancy may cause temporary improvement in inflammatory and autoimmune conditions. This beneficial effect is lost in the postpartum period, resulting in exacerbations of asthma, thyroid disorders, and myasthenia gravis.
- Medication requirements can change drastically during pregnancy and the postpartum period.
- Certain medical conditions in the mother result in neonatal complications that require special resuscitative measures. This is particularly true of many chemical dependency states, and anticipatory management of these patients is essential.

## CHAPTER 179: QUESTIONS &amp; ANSWERS

- 179.1.** A 28-year-old G2P1 at 26 weeks of gestation presents with a recurrent asthma flare. Vital signs are temperature, 36°C, heart rate, 110 beats/min, blood pressure, 120/60 mm Hg, respiratory rate, 28 breaths/min, and O<sub>2</sub> saturation, 96%. She has diffuse expiratory wheezes. Arterial blood gas reveals PO<sub>2</sub> = 90 mm Hg, PCO<sub>2</sub> = 40 mm Hg, and pH = 7.34. Which of the following statements best describes the issues in management with this patient?
- A. Corticosteroids are contraindicated.
  - B. Inhaled  $\beta$ -agonists are first-line therapy.
  - C. Most patients with asthma improve during pregnancy.
  - D. She has a metabolic acidosis.
  - E. Treatment and discharge are likely.

**Answer: B.**  $\beta$ -Agonists followed by corticosteroids are the main stay of asthma therapy during pregnancy. During pregnancy, one-third of asthmatics worsen, one-third improve, and one-third stay the same. Blood gas interpretation must take into account the so-called normal alkalemia of pregnancy, with a PCO<sub>2</sub> of 30 to 32 mm Hg and a compensatory HCO<sub>3</sub> level of 18 to 20 mEq/L. This patient has a relative hypoventilation and may indeed need admission for close observation.

- 179.2.** Which of the following statements best describes treatment for hypertension in pregnancy?
- A. Angiotensin-converting enzyme inhibitors are second-line agents.
  - B. Diuretics are contraindicated in the third trimester.
  - C. Hydralazine is a useful venodilator.
  - D. Labetalol is a first-line oral agent.
  - E. Sodium nitroprusside is the parenteral agent of choice.

**Answer: D.** First-line oral and parenteral agents are hydralazine and labetalol. The former is an arterial dilator. Most antihypertensives are useful in pregnancy; angiotensin-converting enzyme inhibitors and receptor blockers are the exception. Diuretics are second-line agents. Nitroprusside is a second-line agent due to concerns for fetal cyanide toxicity.

- 179.3.** Which of the following statements best describes risk factors for acute myocardial infarction (AMI) and pregnancy?
- A. Anemia is not a risk factor.
  - B. Gestational diabetes does not increase risk.
  - C. Hypotension is an important risk factor.
  - D. Maternal age is inversely associated with risk.
  - E. Maternal smoking increases the risk.

**Answer: E.** Maternal smoking increases the risk. AMI is rare but may occur. Up to 29% of cases have normal coronaries on their angiogram. Risk factors are anemia, diabetes, hypertension, old age, thrombophilia, and smoking. Atherosclerotic lesions are the more likely cause antepartum, whereas coronary dissection and vasospasm are more likely causes postpartum.

- 179.4.** Which of the following statements best describes issues in the evaluation of diabetes mellitus in pregnancy?
- A. Diabetic ketoacidosis (DKA) in pregnancy always presents with hyperglycemia and a low pH.
  - B. Patients with gestational diabetes usually require medical therapy to achieve adequate glycemic control.
  - C. Standard management of non-insulin-dependent diabetes in pregnancy is with continued use of oral medications.
  - D. The American Congress of Obstetricians and Gynecologists recommends universal screening for gestational diabetes.
  - E. The risk of malformations and pregnancy complications is significantly increased in patients with insulin-dependent disease as opposed to those with pregravid, non-insulin-dependent diabetes.

**Answer: D.** The American Congress of Obstetricians and Gynecologists recommends universal screening for pregnant women to achieve prompt diagnosis and minimize related complications. Insulin-dependent diabetes mellitus (IDDM) and non-insulin-dependent diabetes mellitus (NIDDM) place the gravida at increased risk for poor pregnancy outcomes, with the risk being related to inadequate glycemic control. Although patients with IDDM and NIDDM are typically managed with insulin during pregnancy, patients with gestational diabetes often achieve adequate control of their blood glucose level with diet alone. DKA is a potential complication of all forms of diabetes during pregnancy and may present with euglycemia and a minimal change in pH.

- 179.5.** Which of the following statements best describes issues in the management of the pregnant patient with human immunodeficiency virus (HIV)?
- A. Antiretroviral therapy is not appropriate in the first trimester of pregnancy with the exception of efavirenz, which is contraindicated.
  - B. Elective cesarean section is not indicated for all gravidas with HIV and a viral load greater than 1000 copies/mL.
  - C. Postnatal zidovudine therapy in the infant is necessary when the mother has received appropriate antepartum and intrapartum antiretroviral therapy and has a viral load less than 1000 copies/mL.
  - D. The risk of perinatal transmission of HIV is high in the setting of routine screening, intrapartum antiretroviral therapy, and elective cesarean section for patients with a viral load greater than 1000 copies/mL.

**Answer C.** Recommended care for HIV during pregnancy includes intrapartum antiretroviral therapy, postnatal zidovudine prophylaxis, standard treatment for opportunistic infections, and cesarean section for all patients with a viral load greater than 1000 copies/mL. It is appropriate to begin antiretroviral therapy during the first trimester, although it is recommended that these patients be managed by an infectious disease specialist. Postnatal zidovudine is recommended for all infants born to mothers with HIV.

## KEY CONCEPTS

- Chemically induced birth defects are believed to be responsible for approximately 1% to 3% of anomalous births.
- Gestational age is crucial in determination of the impact of any given exposure, especially during organogenesis (days 21–56 of fetal life), when major body organs are formed.
- Human data on teratogenicity and fetal toxicity of medications is often limited, and causal associations are difficult to determine, especially with newer medications.
- In general, the health of the fetus is directly related to the health of the mother, and drugs should be given when the maternal benefits outweigh the risks to the fetus.
- Certain medications should be avoided during pregnancy, if possible, because they are known teratogens or cause potential toxic effects in the newborn; these include anticonvulsants, warfarin derivatives, NSAIDs, sulfonamides, fluoroquinolones, and ACE inhibitors.

## CHAPTER 180: QUESTIONS AND ANSWERS

- 180.1.** A 42-year-old woman who is 7 months pregnant presents with severe, pressure-like chest pain that occurred while she was washing her clothes. The pain radiates to both shoulders and is associated with dyspnea and dizziness. Vital signs show heart rate, 92 beats/min, respiratory rate (RR), 22 breaths/min, blood pressure (BP), 134/70 mm Hg, and O<sub>2</sub> saturation, 97% on room air. She appears pale and diaphoretic and has a subdued affect. Lung examination reveals equal breath sounds without rales, rhonchi, wheezes, or friction rubs. Cardiac examination reveals a regular rhythm at 92 beats/min. There were no murmurs, gallops, or rubs appreciated. An electrocardiogram (ECG) shows ST elevations in leads I, aVL, and V<sub>1</sub>–V<sub>6</sub>, with reciprocal T wave inversions. Of the following, which would be the most appropriate?
- Administer beta blockers.
  - Administer heparin drip, and admit the patient to the critical care unit.
  - Administer thrombolytic therapy.
  - Schedule the patient for computed tomography (CT) angiography of the chest STAT.
  - Start nonsteroidal antiinflammatory drugs (NSAIDs), and schedule the patient for two-dimensional echocardiography.

**Answer: C.** The patient has an acute myocardial infarction (MI) and requires immediate reperfusion therapy. This may be accomplished by thrombolytic therapy or by performing a percutaneous coronary intervention (PCI). Of the choices given, only C provides reperfusion therapy. In this case, treatment of the life-threatening MI in the mother outweighs the possible dangers to the embryo or fetus.

- 180.2.** A 23-year-old woman who is 6 months pregnant was well until earlier in the morning, when she experienced sudden onset of shortness of breath and right-sided sharp chest pain. The pain is worse on inspiration and is not related to exertion, although her dyspnea becomes worse with any activity. She is alert and appears in distress. Her pulse is 112 beats/min, RR, 32 breaths/min, and BP, 98/48 mm Hg. Her temperature is 100.8° F (32° C), and O<sub>2</sub> saturation is 92%. Lung examination reveals splinting of the respirations, with rales and wheezing on the right. Cardiac examination reveals tachycardia. No murmurs, gallops, or rubs were noted. Chest radiograph reveals elevated right hemidiaphragm but no infiltrates. ECG reveals generalized T wave inversions. Of the following, which would be most appropriate?
- Administer a low-molecular-weight heparin subcutaneously, as well as oral warfarin sodium (Coumadin).
  - Administer intravenous ceftriaxone and azithromycin for clinical pneumonia.
  - Administer nebulized bronchodilators, and start prednisone.
  - Administer oxygen, schedule for a diagnostic study, and start heparin.
  - Place a central line, and start early goal-directed therapy for sepsis.

**Answer: D.** On the basis of the information provided, the patient most likely has a pulmonary embolus. The patient is hypoxic and requires oxygen administration and anticoagulation. This may be accomplished with heparin and Coumadin. Coumadin, however, is teratogenic and is contraindicated in pregnancy. The patient has no symptoms of an infectious process; choices B and E are therefore not appropriate. Bronchodilators and steroids are indicated for asthma but not for thromboembolic disease. Choice C is therefore not appropriate.

**180.3.** In determining a causal link between a specific drug and congenital malformations, which of the following may be viewed as confounding factors?

- A. All of these
- B. Genetic background of the fetus
- C. Maternal illicit drug use
- D. Presence of maternal illness
- E. Presence of nutritional deficits

**Answer: A.** The process of establishing teratogenicity of a substance is often flawed. Much of our current knowledge on teratogenicity has been derived from case reports, case-controlled studies, and cohort studies, which are inherently weak in establishing a causal link. These reports are often complicated by a number of confounding factors, which make a causal link difficult to establish. The presence of any of the listed choices may confound results. In the presence of maternal illness, for example, the outcome of pregnancy may be related to the medical condition and not the medication.

**180.4.** Which of the following drugs is a known teratogen?

- A. Acetaminophen
- B. Hydroxycobalamin
- C. Levothyroxine
- D. Penicillin VK
- E. Phenytoin

**Answer: E.** Phenytoin or diphenylhydantoin is an anticonvulsant that is a class D agent and is highly teratogenic. It is associated with the fetal hydantoin syndrome, which is characterized by abnormal ossification of the digits, craniofacial clefts, multiple cardiovascular abnormalities, and impaired neurologic development. It affects 5% to 10% of pregnancies and should be used only if other, safer anticonvulsants fail to control convulsions. The other drugs listed are safe during pregnancy.

**180.5.** Which of the following drugs may be associated with complications in the newborn when used at term?

- A. All of these
- B. Nitrofurantoin
- C. Nonsteroidal antiinflammatory drugs
- D. Propranolol
- E. Sulfonamides

**Answer: A.** All the choices have been associated with complications in the newborn when used at term. Sulfonamides compete with bilirubin for protein-binding sites, leaving large amounts of free bilirubin to diffuse freely into the brain. This results in bilirubin deposition in the infant's brain, thus causing kernicterus. Nitrofurantoin at term has been associated with hemolytic disease of the newborn. Nonsteroidal antiinflammatory drugs are associated with premature closure of the ductus arteriosus. Propranolol at term has been associated with neonatal hypoglycemia, respiratory depression, and neonatal jaundice.

**180.6.** Which of the following antiarrhythmic agents is a known teratogen?

- A. Adenosine
- B. Amiodarone
- C. Digoxin
- D. Lidocaine
- E. Procainamide

**Answer: B.** All the listed antiarrhythmics are safe for use in pregnancy and have not been associated with structural effects except for amiodarone. Amiodarone is a class D agent. It contains a large amount of iodine and may result in congenital goiter and neonatal thyroid abnormalities. In addition, it has been linked to a number of congenital abnormalities affecting growth, cardiac, ophthalmic, and neurologic development. It should only be used for patients who are refractory to other drugs.

## KEY CONCEPTS

- All ED deliveries should be considered high risk. Antepartum hemorrhage, PROM, eclampsia, premature labor, precipitous delivery, malpresentation, and umbilical cord emergencies are overrepresented in emergency deliveries.
- Women in labor who present to the ED are generally best cared for in the obstetric suite. Women with the urge to push or with the head of the infant crowning are at imminent risk of delivery, which should take place in the ED. The benefits of transfer of a woman with an impending high-risk delivery to a perinatal center must be carefully weighed against potential clinical adverse events and possible subsequent medicolegal judgments.
- Most ED deliveries require only basic equipment to cut and clamp the umbilical cord and dry and suction the infant. However, the ED should have additional equipment and trained staff available to care for a newborn requiring further resuscitation.
- Maternal complications of labor and delivery include obstetric trauma, postpartum hemorrhage, uterine inversion and rupture, amniotic fluid embolism, coagulation disorders, and infections. Many of these problems can initially be managed nonsurgically in the ED.
- Deliveries complicated by dystocia, malpresentation, or multiple gestations are life-threatening emergencies. The emergency clinician should develop strategies to treat each of these potential complications of delivery.

## CHAPTER 181: QUESTIONS &amp; ANSWERS

**181.1.** A 23-year-old G2P1 at term presents to the ED with contractions. She has received no prenatal care. She is in moderate distress and feels the urge to push. Which of the following is indicated?

- A. Emergent delivery
- B. Emergent transfer to the obstetrics suite
- C. Formal abdominal ultrasound
- D. Magnesium sulfate 2 g intravenously
- E. Nitrazine testing of pooled vaginal fluid

**Answer: A.** Women with the urge to push or with the head of an infant crowning are at imminent risk of delivery, which should take place in the ED. Women in labor who present to the ED and are not at risk for imminent delivery are best cared for in the obstetrics suite.

**181.2.** A 28-year-old G3P3 presents 2 weeks after delivery with increasing dyspnea on exertion, pedal edema, orthopnea, and easy fatigue. Which of the following statements is true?

- A. Angiotensin-converting enzyme (ACE) inhibitors are contraindicated.
- B. Cardiac function returns to normal in 50% of cases.
- C. Treatment differs from ischemic cardiomyopathy.
- D. Onset is usually gradual.

**Answer: B.** Postpartum cardiomyopathy is associated with a fairly sudden onset of symptoms days to weeks after delivery. It may begin to occur during the end of pregnancy, at which time ACE inhibitors are contraindicated, but these agents are cornerstones of therapy after delivery. Fifty percent of patients will return to normal cardiac status. Mortality is high for those who do not.

**181.3.** Which of the following statements regarding uterine rupture is true?

- A. Emergency ultrasonography has little value.
- B. Emergent vaginal delivery is indicated.
- C. Maternal mortality is high.
- D. Pain is not always present.
- E. The absence of vaginal bleeding precludes rupture.

**Answer: D.** Pain is not always present with uterine rupture, nor is vaginal bleeding always associated. Women at risk are those with a prior classic cesarean section incision or who have had three or more cesarean deliveries. Emergency ultrasonography may show a protruding amniotic sac, hemoperitoneum, or the site of myometrial rupture. Emergency cesarean delivery within 30 minutes is the indicated treatment. Maternal mortality rates in developed countries is less than 1%.

**181.4.** Which of the following statements is not associated with shoulder dystocia?

- A. Fetal complications include clavicular fractures and hypoxic brain injury.
- B. Shoulder dystocia can be overcome by placing traction on the fetal head.

C. Signs of shoulder dystocia include the turtle sign and the presentation of fetal shoulders in a vertical axis.

D. The McRoberts' maneuver frees the anterior shoulder by flexing the mother's legs to a knee-chest position.

**Answer: B.** Traction on the fetal head will extend and abduct the shoulders, which increases bisacromial diameter, thereby worsening the dystocia.

**181.5.** A 33-year-old G1P0 female at 38 weeks by dates presents to the ED with a chief complaint of "my water broke."

The patient reports feeling a gush of fluid several hours earlier but has not yet had any contractions. Which of the following statements best describes issues important in the evaluation and management of this patient?

- A. Fetal tachycardia may be indicative of chorioamnionitis.
- B. Nitrazine paper applied to the patient's pooled vaginal fluid will confirm the presence of amniotic fluid by turning yellow.
- C. Steroids should be given to the mother without delay to accelerate fetal lung maturation.
- D. Tocolytics are indicated and should be administered if the patient develops contractions while in the ED.

**Answer: A.** This patient presents with premature rupture of membranes. Assuming that the fetal gestational age of 38 weeks is confirmed by ultrasound, steroids are unnecessary because fetal lung maturity has already taken place. The incidence of infection may be increased with steroid administration, so it should not be given in this case. Tocolytics are not clearly indicated in this patient because she is at term (ie, fetal lung maturity has taken place), and there is as yet no evidence of chorioamnionitis. Tocolytic use should be discussed with the obstetric consultant. Nitrazine paper should turn blue when it comes into contact with amniotic fluid, indicating a pH over 6.5. Fetal tachycardia and decreased variability of fetal heart rate are both signs of chorioamnionitis.

**181.6.** Which of the following statements regarding fetal heart tracings is false?

- A. Accelerations of heart rate occur during fetal movement.
- B. Baseline heart rate is determined with a 10-minute tracing in the absence of contractions.
- C. Late decelerations rarely result in suboptimal infant outcomes.
- D. Persistent variable decelerations may indicate the need to hasten delivery.

**Answer: C.** Late decelerations indicate uteroplacental insufficiency and should prompt immediate obstetric consultation. Overall, 70% of infants with late decelerations have underlying pathologic conditions or hypoxia.



## KEY CONCEPTS

- Management of life- and limb-threatening injury in the mother comes first. Saving the mother provides the best chance of saving the baby.
- Even in the stable pregnant trauma patient, the fetus is at increased risk of morbidity and mortality.
- The fetus is viable at 24 weeks' gestation. This usually corresponds to when the fundus is at or above the umbilicus.
- Alterations in anatomy and physiology that occur during pregnancy may alter clinical findings related to blood loss and may mask injuries, making methodical assessment essential.
- Stable pregnancies with a viable fetus should be monitored continuously for a minimum of 4 hours after trauma.
- Keeping the mother tilted 30 degrees to the left or manually displacing the uterus may alleviate hypotension and improve perfusion for the mother and fetus.
- Perimortem cesarean section should be initiated for a viable fetus within 4 minutes of no spontaneous return of circulation.
- The use of ionizing radiation to the pregnant patient, including CT and plain radiography, should be minimized, but imaging should not be withheld if it may provide significant diagnostic information. Often, ultrasound, MRI, or a period of observation can preclude the need for ionizing radiation.

## CHAPTER 182: QUESTIONS &amp; ANSWERS

**182.1.** In cases involving minor trauma to pregnant women, which of the following is a predictor of fetal outcome?

- A. Abdominal tenderness
- B. Cardiotocographic monitoring for 4 hours
- C. Maternal blood count and arterial blood gas results
- D. Maternal vital signs
- E. Ultrasonography

**Answer: B.** For women with mild trauma, fetal outcome is not predicted by maternal vital signs, abdominal tenderness, blood tests, or ultrasound results. Only cardiotocographic monitoring for a minimum of 4 hours is useful to predict fetal outcome.

**182.2.** Which of the following factors is most concerning in the presentation of a pregnant trauma patient?

- A. Diastasis of the symphysis pubis
- B. Electrocardiogram (ECG) findings of Q waves in III and aV<sub>F</sub>
- C. Hematocrit 34% in third trimester
- D. Hypotension in the third trimester
- E. Respiratory alkalosis in the third trimester

**Answer: D.** Blood pressure declines in the first trimester, levels out in the second trimester, and then returns to nonpregnant levels during the third trimester. In pregnancy, minute ventilation increases, leading to hypocapnia. Therefore a partial pressure of arterial carbon dioxide (PaCO<sub>2</sub>) of 35 to 40 mm Hg may indicate inadequate ventilation and impending respiratory decompensation. The physiologic anemia of pregnancy, resulting from a 48% to 58% increase in plasma volume and only an 18% increase in red blood cells, results in hematocrits of 32% to 34% by gestational age of 32 to 34 weeks. Electrocardiographic changes include a left-axis shift averaging 15 degrees, caused by diaphragm elevation. Consequently, flattened T waves or Q waves in leads III and aV<sub>F</sub> may be seen.

**182.3.** A 26-week gravid woman presents to the emergency department (ED) after a moderate-speed motor vehicle collision (MVC). The patient is without complaints, and her vital signs are as follows: blood pressure, 100/60 mm Hg; heart rate, 100 beats per minute; and respiratory rate, 18 breaths per minute. Ultrasound examination shows good fetal movement, with a fetal heart rate of 150 beats per minute. What is the appropriate disposition for this patient?

- A. Consult obstetrics for a minimum of 4 hours of cardiotocographic monitoring.
- B. Consult obstetrics for 1 hour of cardiotocographic monitoring.
- C. Consult trauma and obstetrics for admission and serial examinations.

D. Consult trauma and obstetrics for clearance to discharge patient.

E. Discharge the patient with close follow-up with obstetrics.

**Answer: A.** Placental abruption results when the inelastic placenta shears away from the elastic uterus during sudden deformation of the uterus. Because deceleration forces can be as damaging to the placenta as direct uterine trauma, abruption can occur with little or no external sign of injury to the abdominal wall. For the viable fetus (more than 24 weeks' gestation), monitoring is the next step.

**182.4.** A 33-year-old pregnant patient complains of abdominal cramping after a trip and fall accident at home. After 4 hours of cardiotocographic monitoring, the patient was admitted to the obstetric service for further evaluation.

What was the least likely reason for the admission?

- A. Late decelerations on fetal monitoring strip
- B. Leakage of clear fluid from the os
- C. Maternal pulmonary contusion
- D. Persistent uterine tenderness
- E. Two uterine contractions per hour

**Answer: E.** The recommended 4 hours of cardiotocographic observation of the viable fetus should be extended to 24 hours if at any time during the first 4 hours there are more than three uterine contractions per hour, persistent uterine tenderness, a worrisome fetal monitor strip, vaginal bleeding, rupture of the membranes, or if any serious maternal injury is present.

**182.5.** A 26-year-old, 30-week gestation woman presents unresponsive with cardiopulmonary resuscitation (CPR) in progress after a high-speed motor vehicle collision (MVC). On ultrasonography, the fetal heart beat is noted at a rate of 130 beats per minute. The patient lost her vital signs 3 minutes before arrival in the emergency department (ED). What is the most appropriate next step in the management of this patient?

- A. Perimortem cesarean section in the operating room by obstetrics
- B. Perimortem cesarean section with horizontal suprapubic incision
- C. Perimortem cesarean section with vertical incision
- D. Thoracotomy with cardiac massage
- E. Thoracotomy with cross-clamping of the aorta

**Answer: C.** In the event of maternal cardiopulmonary arrest, perimortem cesarean section is indicated. The most experienced physician available should perform the procedure.

## KEY CONCEPTS

- We are in the midst of a silver tsunami, with 10,000 Americans turning 65 every day. Older ED patients have the greatest resource use, longest lengths of stay, and highest admission rates of any age group.
- Delirium is underrecognized by emergency clinicians; recognition of delirium should prompt investigation for life-threatening emergencies, including infection, metabolic abnormalities, and acute coronary syndrome (ACS).
- Many older patients with ACS present without chest pain, especially females and patients older than 85 years. ACS in older adults is more often complicated by acute heart failure due to age-related decreases in left ventricular compliance. Recommendations regarding medical and revascularization therapy in those with non-STEMI and STEMI have no age limitations.
- Almost one-third of older ED patients presenting with abdominal pain are ultimately found to have a surgical condition causing the abdominal pain. Biliary tract disorders are the most common cause of abdominal pain in the older adult.
- Nonspecific complaints such as generalized weakness are among the top ten presenting complaints for older ED patients. Acute onset and focality of symptoms increase the likelihood of stroke or intracranial hemorrhage.
- Mortality from sepsis approaches 40% for patients older than 85 years, with respiratory and genitourinary infections being the most common sources. Older adults with serious infection may have SIRS-negative sepsis.

## CHAPTER 183: QUESTIONS &amp; ANSWERS

**183.1.** The presentation of infection in older patients differs from the presentation in younger patients. Older patients are more likely to have which of the following?

- Benign clinical course
- Elevated inflammatory markers, such as erythrocyte sedimentation rate and C-reactive protein
- Fever
- Left shift of the white blood cells
- Normal white blood cell count

**Answer: E.** Older patients are more likely to have a normal white blood cell count, as well as a normal differential. They are less likely to have fever and signs or symptoms from the infection process. They are more likely to have complications and suffer long-term morbidity or mortality.

**183.2.** Which of the following statements is true regarding acute myocardial infarction (AMI) in older adults?

- Atypical presentations portend a more benign course.
- Atypical presentations increase with age.
- Painless AMIs occur more commonly in men.
- The absence of chest pain is rare.
- Up to 50% of older patients with AMI are asymptomatic.

**Answer: B.** Atypical presentations of AMI increase with age and are of equal severity as typical cases. Although atypical cases are frequent, only 2% to 6% are asymptomatic. Women have painless presentations more than men, and present with abdominal pain almost one-third of the time. The absence of chest pain is not uncommon.

**183.3.** A 74-year-old man with a history of hypertension and hyperlipidemia presents to the ED with acute onset of severe, nontraumatic, left flank pain. His vital signs include a heart rate of 72 beats/min and blood pressure of 120/70 mm Hg. Which approach to his care would be most appropriate?

- Arrange for him to be in the observation unit overnight for serial abdominal examinations to help clarify his diagnosis.
- Consider abdominal aortic aneurysm only after the patient's urinalysis and renal ultrasound are negative for nephrolithiasis.
- Diagnose him with nephrolithiasis without any further testing.
- Evaluate for a possible abdominal aortic aneurysm.

**Answer: D.** Vascular disease prevalence increases with age. Vascular emergencies remain some of the most time-sensitive and highly morbid causes of abdominal pain in the older patient and should always be considered first, particularly for abrupt-onset symptoms.

**183.4.** Which of the following statements is true about complaints of nonspecific weakness in older ED patients?

- Admission to a skilled nursing facility for failure to thrive should be the rule.
- Emergency clinicians should assume that the weakness is a stroke until proven otherwise.
- The most common underlying causes of complaints of nonspecific weakness are infection, metabolic derangements, and malignancy.
- Weakness is a part of natural aging.

**Answer: C.** With nonspecific weakness, infections, metabolic abnormalities, and malignancies are the most common findings in older patients. Nonspecific complaints such as generalized weakness are consistently among the top ten presenting complaints for older ED patients. Important historical features include timing and focality of symptoms. If patients have acute focal weakness, a stroke or intracranial hemorrhage is very likely. However, in the absence of focal weakness, medical causes are more likely.

**183.5.** How does the presentation of abdominal pain in older adults differ from that in younger adults?

- Bedside abdominal palpation and examination is the emergency clinician's most sensitive tool.
- Older patients are less likely to have a surgical emergency.
- Older patients often have delayed presentations.
- Older patients uniformly mount a febrile response when they have a surgical emergency.

**Answer: C.** Older patients often have delayed presentations of abdominal emergencies. Cognitive issues, altered pain perception, high stoicism, and transportation barriers may be factors in delayed presentation. Older patients are more likely to have a surgical cause of their abdominal pain. Imaging studies, particularly computed tomography, are often appropriate to facilitate diagnosis and are highly diagnostic in the older patient population.

## KEY CONCEPTS

- We recommend that advanced age ( $\geq 70$  years) be used as triage criteria for transfer to a trauma center and activation of a trauma team.
- Emergency clinicians should consider shock in all older trauma patients. Because vital signs, including tachycardia and hypotension, are unreliable to detect hemodynamic instability in older adults, emergency clinicians should closely follow alterations in mental status, urine output, and skin perfusion.
- Older adults are at significant risk from shock, yet they are also at risk from aggressive resuscitation. Resuscitation should be rapid but should also include frequent reassessments of vital signs, respiratory status, and other potential indicators of shock. Start resuscitation with blood in the patient with significant bleeding, signs of hemodynamic instability, or significant injuries (eg, unstable pelvic fracture).
- Older patients are at high risk of hypothermia and develop pressure ulcers more rapidly. They should be removed from backboards as soon as possible, and rectal temperature should be routinely checked in the secondary survey.
- Clinical decision tools for radiographic imaging have generally excluded older patients. A low threshold for imaging should be used for older adults with trauma, and CT should be used as the primary modality, except for extremity imaging.
- Falls are the leading cause of injury-related death in older adults, and ground-level falls can result in major injuries. Although there is debate about the effectiveness of interventions for secondary prevention of falls, we advise that emergency clinicians assess gait and notify the primary care physician, and we recommend close follow-up at a minimum. Engaging social services, including arranging a home safety visit, may be beneficial.
- Among patients with TBI or hemorrhagic injuries, anticoagulation predicts poor outcome. Rapidly reverse warfarin with a PCC or FFP if a PCC is unavailable.
- Rib fractures and pulmonary contusions are associated with poor outcomes in older patients. Patients with flail chest, two or more rib fractures, or pulmonary contusions should be hospitalized for monitoring, pulmonary care, and analgesia.
- Older adults with hip fractures have improved survival on a dedicated orthogeriatric service. Consider transfer of patients to hospitals with this service available.
- Routinely screen for elder abuse. A valid screening question is: "Has anyone close to you tried to hurt you or harm you recently?"

## CHAPTER 184: QUESTIONS &amp; ANSWERS

- 184.1.** A 76-year-old man is brought to the emergency department (ED) after a fall at home. The paramedics tell you that he slipped in the shower and struck his head on a tile floor. The patient is awake and alert. He is unsure if he lost consciousness and complains of headache. When you obtain a computed tomography (CT) scan of his head, it reveals evidence of a cerebral contusion. The paramedic tells you that he has a history of severe congestive heart failure (CHF) and takes warfarin and furosemide daily. When he returns from CT, he seems slightly confused. Laboratory tests are pending. What is the best initial treatment?
- Administer a prothrombin complex concentrate (PCC).
  - Administer desmopressin (DDAVP) intravenously (IV).
  - Administer protamine sulfate IV.
  - Transfuse 2 units fresh frozen plasma.
  - Transfuse one bag of platelets.

**Answer: A.** Prompt reversal of anticoagulation is important because approximately 5% of older adults is on warfarin, and others have pathologic coagulopathy. Specific considerations for reversing coagulation abnormalities in older trauma patients are the volume of reversal agents required and corresponding risk of fluid overload. PCCs require minimal volume compared with fresh-frozen plasma (FFP) but are costly. To reverse anticoagulation fully, 1 to 2 L of FFP may be required, presenting a limitation to rapid reversal in older patients at risk of fluid overload. Platelets, protamine, and DDAVP will not reverse the elevated international normalized ratio caused by warfarin.

- 184.2.** Which of the following is the most common cervical spine fracture in geriatric trauma patients?
- Anterior wedge fracture
  - Compression fracture
  - Jefferson fracture
  - Spinous process fracture
  - Type 2 odontoid fracture

**Answer: E.** Because of the relative immobility of the cervical spine related to degenerative joint disease, the most common level of cervical spine injury in older adults is C1 to C3, a higher level than in younger patients. Among these upper cervical spine fractures, the most common is a type 2 odontoid fracture.

- 184.3.** An 80-year-old woman presents after a motor vehicle accident (MVA). Her vital signs on arrival are as follows: heart rate of 112 beats/min, blood pressure of 88/65 mm Hg, respiratory rate of 18 breaths/min, and oxygen saturation measured by pulse oximetry ( $\text{SpO}_2$ ) of 98%. The paramedic tells you that she has a history of CHF and takes furosemide daily. The primary survey does not reveal an obvious source of bleeding. Which of the following treatments is most appropriate to address the patient's tachycardia and hypotension while searching for its cause?
- Give a bolus of 500 mL warmed normal saline.
  - Give 2 units of non-crossmatched type O blood.
  - Run an infusion of warm normal saline wide open.
  - Start dopamine at a low dose.
  - Type and match and wait for type-specific blood.

**Answer: A.** The most prudent approach in the hypotensive older trauma patient is controlled boluses of warmed isotonic fluids, with frequent assessment of physical examination, vital signs, pulse oximetry, and urine output. Resuscitation with crystalloid may correct the patient's hypotension, obviating the need for transfusion. The patient's hypotension must be addressed immediately, and treatment should not be delayed for type-specific blood. Given her history of CHF, a wide open infusion of normal saline without an endpoint should not be administered. Vasopressors such as dopamine should not be given to any trauma patient, except in extreme circumstances. If the patient had an obvious source of hemorrhage, use of non-crossmatched type O blood would be appropriate as a first step, and starting with 1 unit would be appropriate.

**184.4.** A 76-year-old man presents after slipping and falling down several stairs at home. The patient is awake and alert and unsure if he lost consciousness after the fall. He complains of chest pain and has left chest wall tenderness and crepitance on examination. When you obtain a CT scan of his chest, it reveals four contiguous

lateral rib fractures. The patient's pain is only moderately relieved by 0.15 mg/kg of morphine sulfate IV. What is the most appropriate disposition for this patient?

- A.** Admission for pain control with IV opioids
- B.** Admission with anesthesia consultation for pain management
- C.** Continued observation in the ED for 6 additional hours of IV opioid management, followed by reassessment
- D.** Discharge home with oral opioids

**Answer: B.** Geriatric trauma patients with severe pain from rib fractures often require hospitalization to allow adequate and safe pain management, and those with flail segments or larger numbers of rib fractures may require intensive care unit admission. Pain control is of particular importance because rib fractures will lead to splinting and atelectasis and increase the risk of pneumonia. Analgesia can be administered with IV opioids via patient-controlled analgesia or an epidural analgesic. An anesthesia consultation is appropriate for the older rib fracture patient without pain relief from parenteral opioids.

## KEY CONCEPTS

- Those with a chronologic age of 65 years or older are commonly referred to as older adults (or the elderly), but physiologic age is more indicative of a drug's therapeutic or toxicologic effect. Besides age, overall patient assessment should include organ function, comorbidity, and functional status to guide drug dosing.
  - Pharmacokinetic and pharmacodynamic changes that occur with age need to be considered to optimize drug dosing and minimize toxicity in older adults. In most cases, a start low, go slow approach is recommended. Multiple or repeated dosing is more likely to lead to drug accumulation compared to single doses in the ED.
  - Polypharmacy is common in older adults, predisposing them to adverse drug effects, drug interactions, and functional and cognitive impairment. Some of these medications do not have legitimate indications or may be inappropriate.
  - There are published lists of potentially inappropriate medications, such as the Beers list and the STOPP and START criteria, but there are limited studies to enable extrapolation to the ED setting.
  - Of all drug-related presentations to the ED, warfarin-induced bleeding has been shown to be the most common in older adults.
- However, the use of newer oral anticoagulants, such as direct thrombin inhibitors and factor Xa inhibitors, has been increasing. These newer agents undergo renal elimination; thus, drug accumulation is a concern in older adults.
- Older adults often present to the ED with altered mental status. Drug-related causes such as anticholinergic medication burden should be considered in the differential diagnosis.
  - Geriatric patients with pain-related complaints are less likely to receive analgesics in the ED compared to younger adults, placing them at risk for poor pain control. Dosing of opioids should be cautious, with frequent monitoring and titration. Given the availability of alternative opioids, the use of meperidine should be avoided.
  - A growing number of institutions have pharmacists practicing in the ED. In geriatric EDs, there is a great opportunity to integrate and consult with pharmacists, given the myriad drug therapy issues that can lead to suboptimal care.

## CHAPTER 185: QUESTIONS &amp; ANSWERS

**185.1.** Which of the following pharmacokinetic change in older adults is associated with increased plasma concentration of drug?

- Decrease in absorptive capacity in an orally administered medication
- Decreased glomerular filtration rate in a renally eliminated medication
- Increase in gastric pH in a medication that is a weak base
- Increased liver blood flow in a high-extraction ratio medication
- Increased total body water in hydrophilic medications

**Answer: B.** Decrease in glomerular filtration rate is common with age. This leads to decreased elimination and increased plasma concentration of a drug. All other options listed would lead to decreased plasma drug concentrations. Liver blood flow, glomerular filtration rate, total body water, and absorptive capacity decrease with age. However, gastric pH increases.

**185.2.** Which of the following is the most appropriate strategy for analgesic provision in an older patient with renal insufficiency and severe abdominal pain in the emergency department?

- Hydromorphone 0.5 mg IV, followed by the same dose in 15 minutes, if needed
- Ketorolac, 30 mg IV qid
- Meperidine, 50 µg IV every 2 hours
- Morphine, 4 mg IV every 2 hours
- Oxycodone/acetaminophen, 5/235 mg orally every 2–4 hours

**Answer: A.** One strategy that has been used successfully in older adults is a two-step hydromorphone protocol. Patients are given 0.5 mg IV hydromorphone, which is repeated in 15 minutes if the patient desires another dose when asked, “Do you want more pain medication?” Hydromorphone does not have active metabolites that would accumulate with renal insufficiency, so it would be an appropriate option for severe pain. Ketorolac should be avoided

in older adults with renal insufficiency because the inhibition of prostaglandins can decrease renal blood flow. Meperidine use is no longer recommended because of a neurotoxic metabolite and accumulation in renal insufficiency. Morphine has an active metabolite that also accumulates in renal insufficiency. Oxycodone-acetaminophen given orally is not appropriate for severe acute pain due to delayed onset of effect. Bioavailability of oral medications may further be delayed in older adults.

**185.3.** Which of the following statements is true regarding reversal of anticoagulation in older adults who are bleeding?

- Intravenous vitamin K can be avoided if factor concentrates are provided.
- Dabigatran is not removed by hemodialysis because of high protein binding.
- Prothrombin complex concentrate is preferred to plasma transfusion.
- Plasma transfusion is preferred to prothrombin complex concentrate.
- Factor Xa inhibitors can be removed by hemodialysis because of low protein binding.

**Answer: C.** Prothrombin complex concentrate has a lower volume of administration, which is beneficial for volume-restricted older adults. It is preferred to plasma transfusion based on low-level evidence. Intravenous vitamin K should be given with factor concentrates to sustain the reversal of anticoagulation. Dabigatran has low protein binding and thus can be removed by prolonged hemodialysis, but this is often not practical when emergent bleeding cessation is required. Factor Xa inhibitors are highly protein-bound and are not removed by hemodialysis.

**185.4.** Which of the following medications prescribed on discharge is most likely to interact in an older patient taking warfarin?

- Albuterol inhaler for asthma
- Ciprofloxacin for urinary tract infection
- Insulin NPH for hyperglycemia
- Oxycodone for fracture pain
- Promethazine for nausea



**Answer: B.** Studies of harmful drug interactions in older adults have shown that the initiation of antibiotics in patients taking warfarin can lead to bleeding. Ciprofloxacin can lead to an elevation in the international normalized ratio (INR) due to disruption of vitamin K synthesis in patients taking warfarin. Thus, more frequent monitoring is required when ciprofloxacin is initiated. The other options listed do not interact with warfarin. However, oxycodone and promethazine can be harmful because of central nervous system effects, potentially leading to falls.

**185.5.** Which of the following statements is true regarding neurologic emergencies in older adults?

- A.** Ampicillin is added for the treatment of bacterial meningitis for additional coverage against *Enterococcus faecalis*.
- B.** Anticholinergic medication use is not associated with delirium.
- C.** Haloperidol, 10 mg IV, is recommended for acute agitation due to underlying psychiatric illness.
- D.** In patients with ischemic stroke who are older than 80 years, alteplase may be administered up to 4.5 hours after the onset of symptoms, according to guidelines.
- E.** Large doses of haloperidol given via the IV route have been associated with QTc interval prolongation

**Answer: E.** There is a US Food and Drug Administration (FDA) black box warning regarding the use of haloperidol and QTc interval prolongation. This risk is increased with large doses given intravenously. Polypharmacy in older adults also puts them at risk for drug interactions due to concomitant QTc-prolonging agents. Doses of haloperidol should be less than 5 mg in most older adults. Ampicillin is added for bacterial meningitis to cover *Listeria monocytogenes*. Although recent evidence has extended the 3-hour time window to 4.5 hours for receiving alteplase after the onset of stroke in a small subset of patients, those older than 80 years are not eligible, according to guidelines. Anticholinergic medications are known to be associated with delirium and sedation.

## KEY CONCEPTS

- Elder mistreatment, which includes physical abuse, sexual abuse, neglect, emotional/psychological abuse, abandonment, financial/material exploitation, and self-neglect, is common and may have serious medical and social consequences.
- Elder mistreatment is significantly under-recognized by emergency clinicians and under-reported to the authorities.
- Signs suggestive of potential elder abuse and neglect that should be recognized by emergency clinicians may exist in the medical history, physical examination, and medical/laboratory markers.
- Emergency clinicians should be vigilant in assessing for the possibility of elder abuse or neglect and routinely ask elderly patients about mistreatment, even in the absence of signs and symptoms.
- Emergency clinicians should hospitalize elderly patients who are in immediate danger or implement a care plan that prevents them from having any contact with the suspected abuser(s).
- Emergency clinicians must respect the wishes of an older adult with decision-making capacity who refuses interventions and desires to return to an abusive situation. If possible, the clinician should provide education and give information about available resources.
- The wishes of a competent elderly patient are required to be respected, even if the patient is not willing to accept interventions.
- Emergency clinician should always strongly consider reporting known or suspected cases of elder abuse or neglect to the authorities, and, in most states, emergency clinicians are mandated reporters.

## CHAPTER 186: QUESTIONS &amp; ANSWERS

**186.1.** A 70-year-old man who lives alone but has 12 hours per day of a home attendant is brought to the emergency department (ED) by his daughter, who found him in his caregiver's home with severe bruising. On examination, he had multiple bruises at varying stages of healing on the chest and arms, as well as a possible pattern injury—a bruise in the shape of a rectangle—across his left chest. What should you do?

- A. Ask the daughter to make a report to adult protective services (APS), because she is the one who found him.
- B. Contact the long-term care ombudsman.
- C. Do not make a report because he has a long history of falls.
- D. File a report with APS or law enforcement if your suspicion for abuse is high.
- E. Interrogate the caregiver. If she denies abuse, do not report it.

**Answer: D.** The patient should be asked questions in a nonthreatening atmosphere, separate from the caregiver. If a clinician still has high suspicion, a report should be made to APS and/or law enforcement. The physician has the obligation to make the report. The long-term care ombudsman should be contacted only if the suspected abuse occurs in a facility, such as a nursing home.

**186.2.** A 72-year-old female is brought to the emergency department (ED) by paramedics for “not eating for 5 days” according to her family. The paramedics noted that she was covered in urine and feces and that the house was filthy, and she was found lying on the floor. On examination, she is noted to have a stage 4 pressure ulcer on her sacrum, which appears infected. Which of the following concerning for neglect?

- A. Delay in seeking care
- B. Evidence of dehydration
- C. Poor hygiene
- D. Pressure ulcer
- E. All of the above

**Answer: E.** All of the above signs are potential markers for neglect.

**186.3.** A 69-year-old man with dementia presents to the emergency department (ED) with pneumonia and

delirium. He is very confused, and his cognition is markedly worse than his baseline. You are called to the bedside because his adult daughter is at the bedside asking him to sign a legal form giving her the deed to his house. What should you do?

- A. Perform an assessment of cognition and capacity and document it on the chart.
- B. Request that the hospital lawyer and notary be present.
- C. Tell her that there must be two witnesses present for the form to be legal.
- D. Tell the daughter that if there are other children, they must be present for the form to be valid.
- E. Tell the daughter that she must be the health care proxy for the form to be legally binding.

**Answer: A.** When an elderly patient has delirium or is confused because of another medical condition, he or she may lack the capacity to enter into a legal agreement or sign a legal document. The patient described is clearly too confused to understand all of the ramifications of signing his home over to another person. Confusion resulting from delirium or dementia is a risk factor for elder financial abuse.

**186.4.** An 85-year-old female with dementia, who lives in a skilled nursing facility, presents with bruises on her bilateral inner thighs. The facility staff states that she sustained these while being lifted from her bed to a chair. Who should you notify?

- A. Adult protective services (APS)
- B. Law enforcement
- C. Sexual assault response team
- D. The long-term care ombudsman
- E. All of the above

**Answer: E.** The physical findings are concerning for sexual abuse. Therefore law enforcement and APS should be called, as well as the sexual assault response team to collect forensic evidence. Because the patient lives in a facility, the long-term care ombudsman should also be called to investigate the possible abuse.

## KEY CONCEPTS

- Immunocompromised persons who present with acute infections, especially those that are neutropenic, may appear deceptively benign initially, their symptoms and signs often mimicking noninfectious complications, only to deteriorate rapidly if they are not evaluated and treated urgently. Early use of broad-spectrum antibiotics is indicated after obtaining appropriate cultures of all potential sites of infection, including intravascular catheters.
- Immunocompromised patients can have serious local or systemic infections without fever, which may be manifested by unexplained tachypnea or tachycardia, mental status changes, metabolic acidosis, increased volume requirements, rapid changes in serum glucose or sodium concentration, or acute abdominal pain.
- In neutropenic cancer patients, most severe infections and almost all instances of bacteremia occur when the neutrophil count is less than 100 cells/mL.
- In neutropenic patients, the temperature should be measured orally or tympanically, not rectally.
- In neutropenic cancer patients, pneumonia and anorectal infection are more likely to be associated with bacteremia than other localized infections.
- Gram-positive organisms are responsible for most serious infections in neutropenic cancer patients, but infections due to gram-negative organisms are more rapidly lethal.
- Neutropenic cancer patients with chemotherapy-induced oral mucositis can develop rapid onset of fever with shock, acute respiratory distress syndrome and rash due to viridans streptococci.
- If the chest radiograph is normal or inconclusive but there is still suspicion for pneumonia, CT of the chest without contrast should be obtained because pneumonia is often detected by chest CT in febrile neutropenic patients with normal findings on the chest radiograph.
- Broad-spectrum intravenous antimicrobial therapy with cefepime, meropenem, imipenem, or piperacillin-tazobactam, should be initiated promptly in the febrile neutropenic patient, with an aminoglycoside added for the more seriously ill patient. Aztreonam *plus* vancomycin should be administered to those with serious penicillin-allergy. Empirical fluoroquinolone therapy should be avoided except for specific indications.
- Some low-risk febrile neutropenic patients may not require admission to the hospital, but can be managed in a short stay observation unit or be discharged home from the ED.
- Patients with cell mediated immune deficiency including those on high dose corticosteroids may develop life-threatening infections with intracellular bacteria (*Listeria*, *Salmonella*, tuberculosis), fungi (*Cryptococcus*, *Coccidioides*, *Histoplasma*), herpes simplex virus, and varicella-zoster virus.
- Patients with end stage renal disease on hemodialysis who develop pneumonia, *C. difficile* disease, or infections of dialysis access sites have high mortality.
- Functional or surgical asplenia predisposes to fulminant infection with pneumococci and other encapsulated organisms (*H. influenzae*, *N. meningitidis*, and *Capnocytophaga canimorsus* after dog bites) and, when seen early, may be misdiagnosed as a viral illness, gastroenteritis, or food poisoning.
- High doses of corticosteroids cause profound dysfunction of neutrophils and mononuclear cells and impair cell-mediated immunity (CMI), resulting in an increase in infections caused by pyogenic bacteria, varicella-zoster and herpes simplex viruses, tuberculosis, and a wide variety of other bacteria, fungi, and parasites.

## CHAPTER 187: QUESTIONS &amp; ANSWERS

**187.1.** What is the most common site of infection in febrile neutropenic patients?

- A. Gastrointestinal tract
- B. Perineum and anorectal area
- C. Respiratory tract
- D. Skin and soft tissue
- E. Urinary tract

**Answer: C.** The respiratory tract is the most common site of infection, with 25% of infections in the lung and another 25% in the mouth or pharynx (and an additional 5% in the nose or sinuses). Still, all neutropenic patients with fever need to have a thorough physical examination because an undiagnosed infection can cause severe morbidity or mortality.

**187.2.** A 49-year-old diabetic male who has been receiving chemotherapy for non-Hodgkin's lymphoma presents with fever and facial pain. Six weeks ago, he was treated with broad-spectrum antibiotics for fever but had negative cultures of blood and urine. He is taking ciprofloxacin as prophylaxis against infection. Examination is normal except for a purple-black lesion on his hard palate that looks like dried blood. A complete blood count shows severe neutropenia. In addition to blood cultures and chest radiography, what action should be taken immediately?

- A. Administer intravenous clindamycin or ampicillin-sulbactam.
- B. Administer intravenous levofloxacin.
- C. Observe in the emergency department (ED) because he may be a candidate for home antibiotic therapy if other laboratory tests are normal, if he appears stable after an initial dose of antibiotics, and if his oncologist agrees.
- D. Obtain a computed tomography (CT) scan of the paranasal sinuses and initiation of intravenous antifungal therapy in the hospital.
- E. Undertake coagulation tests to check for a bleeding disorder induced by chemotherapy.

**Answer: D.** This patient has invasive aspergillosis or mucormycosis until proven otherwise. These fungi invade tissues and produce life-threatening necrotizing infections in cancer patients with neutropenia, as well as in diabetic patients, especially those who have received broad-spectrum antibiotics. CT scan will often show deep extension of the infection into the sinuses, orbit, or brain. The initial lesion in the palate or nose is often mistaken for a benign process. The antibiotics listed in A and B are incorrect. The most appropriate empirical antibiotic regimen is cefepime or piperacillin-tazobactam, with or without an aminoglycoside, in addition to antifungal therapy. He is not a candidate for home therapy.

- 187.3.** A 27-year-old male presents to the emergency department (ED) with acute onset of fever, chills, headache, myalgias, vomiting, mild abdominal cramping, and diarrhea for 8 hours. A splenectomy was performed 15 years earlier when he was treated for lymphoma, which has been in remission since then. He is not taking any medications and has been well. Vital signs are as follows: pulse, 125 beats/min; blood pressure, 110/60 mm Hg; respiratory rate, 20 breaths/min; and temperature, 39.5° C. His mental status is normal, and he has mild generalized abdominal tenderness. What is the most appropriate treatment for this patient at this time?
- A.** Blood cultures followed by immediate administration of ceftriaxone or cefotaxime, with or without vancomycin.
  - B.** Hydration, antipyretic, antiemetic, and observation in the ED.
  - C.** Immediate hospital admission with observation and frequent abdominal examinations.
  - D.** Lumbar puncture.
  - E.** Stool testing for occult blood and fecal leukocytes.

**Answer: A.** This patient is at high risk for overwhelming postsplenectomy sepsis, usually caused by *Streptococcus pneumoniae*. Persons who have undergone splenectomy for a hematologic disorder or lymphoma are at much higher risk for overwhelming postsplenectomy infection than are those undergoing splenectomy for trauma. The initial prodromal symptoms may be misdiagnosed as a viral illness, gastroenteritis, or food poisoning before there is abrupt deterioration with development of septic shock with disseminated intravascular coagulation, purpura, and multiorgan dysfunction. After blood cultures are obtained, he should immediately receive antimicrobials active against pneumococci, meningococci, and *Haemophilus influenzae*. He can be investigated for other possible etiologies of his symptoms after this initial critical action is taken.

- 187.4.** Which answer is correct regarding diagnosis and management of patients on long-term high-dose corticosteroid therapy?
- A.** Acute, short-term administration of high-dose corticosteroids, but not long-term administration, can make the diagnosis of peritonitis particularly difficult.
  - B.** After laceration repair, sutures should left in place for 50% to 100% longer than is usual.
  - C.** Complications of chronic corticosteroid use include pancreatitis, pseudotumor cerebri, avascular necrosis of bone, cataracts, myopathy, spontaneous vertebral fractures, psychosis, and hypoglycemia.
  - D.** Long-term corticosteroid use is frequently accompanied by peripheral blood neutrophilia.
  - E.** Most serious infections in these patients are caused by organisms associated with defective cell-mediated immunity (CMI), such as severe or disseminated varicella-zoster and herpes simplex infections, tuberculosis, *Listeria*, *Cryptococcus*, and histoplasmosis.

**Answer: B.** Corticosteroids interfere with wound healing, so sutures need to remain in place longer than is usual for the type of laceration. Despite the profound defect in CMI that occurs with long-term corticosteroid use, infections with organisms associated with defective CMI are unusual. Most serious infections in these patients are caused by pyogenic bacteria, such as *Staphylococcus aureus*, streptococci, and gram-negative bacilli. Both short-term and long-term administration of corticosteroids interfere with the diagnosis of peritonitis. These patients will have poorly localized abdominal discomfort with minimal findings on examination. All the conditions listed in B are associated with chronic corticosteroid use—except hypoglycemia. Corticosteroid use is associated with hyperglycemia, hyperosmolar nonketotic diabetic coma, and diabetic ketoacidosis.

## KEY CONCEPTS

- The possibility of organ rejection, infection, or drug toxicity should be considered in all organ transplant patients who present to the ED, because the presentations can be subtle.
- Anatomic issues related to solid organ transplantation are specific to the organ transplanted and time since transplantation but generally involve thrombosis, stricture, or breakdown and leak of the anastomoses.
- Timing since surgery, state of immunosuppression, exposures and risk factors, and graft function should be taken into account at each ED evaluation.
- Differentiation of infection and rejection is often difficult in the ED. Determination is often made only after biopsy of the transplanted organ or positive culture results are identified.
- Infections that occur 1 to 6 months after transplantation are generally immunomodulating viral infections, such as with CMV, or opportunistic infections.
- A patient's inability to take oral immunosuppressants for even a single day should be considered an emergency condition.
- When prescribing new drugs, care should be taken to avoid drug interactions and toxicity of immunosuppressants.

## CHAPTER 188: QUESTIONS &amp; ANSWERS

**188.1.** A 42-year-old man presents with fever, cough, and shortness of breath. He reports a history of renal transplant approximately 2 months ago. He denies surgical site pain or changes in urine output. Chest radiograph reveals a diffuse interstitial pattern. Although concerned that his fever could be caused by acute organ rejection, you are also concerned about pneumonia. What is the most likely cause of his pneumonia?

- A. Cytomegalovirus (CMV)
- B. Herpes simplex
- C. *Klebsiella pneumoniae*
- D. *Listeria monocytogenes*
- E. *Staphylococcus aureus*

**Answer: A.** CMV is the most prevalent cause of pneumonia in the solid organ transplant patient. Infection typically occurs 1 to 6 months after transplant. Infections are serious and often fatal, but aggressive supportive care, as well as treatment with ganciclovir and CMV-specific immunoglobulin, improves outcome. *Pneumocystis jiroveci* pneumonia is also common and can be indistinguishable from CMV except by bronchoscopy. All infections are more common in immunocompromised individuals, with herpes

and *Listeria* particularly more common in solid organ transplant patients. *Klebsiella* is typically seen in alcoholics, but it can occur in any patient population. *Staphylococcus pneumoniae* is typically severe and can cause abscess formation or empyema.

**188.2.** Cyclosporine and tacrolimus are both commonly used immunosuppressant medications in solid organ transplant recipients. Unfortunately, both of them can cause significant side effects. Which organ is most at risk of toxicity from these medications?

- A. Brain
- B. Heart
- C. Kidney
- D. Liver
- E. Lung

**Answer: C.** Both exhibit dose-related nephrotoxicity. Tacrolimus has an improved side effect profile over cyclosporine, but it can still cause significant adverse effects. Both exhibit significant drug interactions, and care should be taken when adding or subtracting medications because drug levels can be altered easily, resulting in either toxic or subtherapeutic levels.



## KEY CONCEPTS

- The ED should have a written plan of action to deal with violence that integrates the activities of ED staff, hospital administration, security, and local authorities.
- ED staff should be trained to recognize potentially violent individuals and to intervene with verbal de-escalation techniques prior to physical or chemical restraint when possible.
- The emergency clinician should be familiar with the use of physical and chemical restraints and the breadth of options for chemical sedation, as well as situations suggesting use of particular medications. For the undifferentiated severely agitated patient requiring rapid tranquilization, we recommend a benzodiazepine (such as, lorazepam) either alone or with a first-generation antipsychotic (such as, haloperidol).
- The possibility of an organic (medical) cause of aggressive behavior should be considered in all violent patients, even those with known psychiatric disease.
- The negative reactions from difficult patient encounters may result in undesirable implications for both patients and their ED caregivers,

including compromised patient care, compassion fatigue, and professional burnout.

- Management of the difficult patient can be optimized by understanding the multiple issues contributing to the impaired physician-patient relationship, including factors of the ED setting (such as, time constraints and lack of privacy), individual physician influences (such as, personal bias and poor communication), and patient contributions to the interaction, including behavioral, social, and substance use issues.
- Pejorative stereotypes of difficult patients should be avoided—to aid in physician strategies for these challenging encounters one should instead aim to characterize the patient's primary difficult behaviors, such as dependent clinger, entitled demander, manipulative help rejecter, and self-destructive denier.
- Strategies, including understanding one's own biases and reactions and optimizing communication, are helpful in dealing with the impaired physician-patient relationship.

## CHAPTER 189: QUESTIONS &amp; ANSWERS

**189.1.** Which of the following is a positive predictor of violent behavior in patients?

- Age
- Ethnicity
- Gender
- Level of education
- Marital status

**Answer: C.** Identification of potentially violent patients is difficult, with male gender, prior history of violence, and drug or ethanol abuse the only positive predictors. Ethnicity, diagnosis, age, marital status, and education are not reliable identifiers.

**189.2.** Which of the following medications is associated with the highest incidence of sedation, hypotension, and anticholinergic symptoms?

- Droperidol
- Haloperidol
- Loxapine
- Molindone
- Thioridazine

**Answer: E.** Antipsychotics can be divided into low potency (including chlorpromazine and thioridazine), midrange potency (such as, loxapine and molindone), and high potency (such as, haloperidol and droperidol). The incidence of sedation, hypotension, and anticholinergic symptoms is highest in the low potency group, and the incidence of extrapyramidal symptoms is greatest in the high potency group.

**189.3.** Which of the following antipsychotic medications is associated with the highest incidence of extrapyramidal symptoms?

- Chlorpromazine
- Haloperidol
- Loxapine
- Molindone
- Thioridazine

**Answer: B.** Antipsychotics can be divided into low potency (including chlorpromazine and thioridazine), midrange potency (such as, loxapine and molindone), and high potency (such as, haloperidol and droperidol). The incidence of extrapyramidal symptoms is greatest in the high potency group, and the incidence of sedation, hypotension, and anticholinergic symptoms is highest in the low potency group.

**189.4.** Which of the following disorders is best defined as a pattern of instability of interpersonal relationships, self-image, and affect and marked impulsiveness that begins by early adulthood and presents in a variety of contexts?

- Antisocial personality disorder
- Borderline personality disorder
- Dependent personality disorder
- Histrionic personality disorder
- Paranoid personality disorder

**Answer: B.** Borderline personality disorder is a pattern of instability of interpersonal relationships, self-image, and affect and

marked impulsiveness beginning by early adulthood and present in a variety of contexts. It may be indicated by five or more of the following:

1. Frantic efforts to avoid real or imagined abandonment
2. A pattern of unstable and intense interpersonal relationships characterized by alternating extremes of idealization and devaluation
3. Identity disturbance: Markedly and persistently unstable self-image or sense of self
4. Impulsiveness in at least two areas that are potentially self-damaging (eg, spending, sex, substance abuse, reckless driving, and binge eating)
5. Recurrent suicidal behavior, gestures, threats, or self-mutilating behavior
6. Affective instability caused by a marked reactivity of mood (eg, intense episodic dysphoria, irritability, or anxiety usually lasting a few hours and only rarely more than a few days)
7. Chronic feelings of emptiness
8. Inappropriate, intense anger, or difficulty controlling anger (eg, frequent displays of temper, constant anger, and recurrent physical fights)
9. Transient, stress-related paranoid ideation, or severe dissociative symptoms

**189.5.** A patient demonstrates inappropriate sexually seductive behavior while being interviewed by her physician. This characteristic is most consistent with which of the following personality disorders?

- Antisocial personality disorder
- Borderline personality disorder
- Dependent personality disorder
- Histrionic personality disorder
- Paranoid personality disorder

**Answer: D.** Histrionic personality disorder is a pattern of excessive emotionality and attention seeking beginning by early adulthood as indicated by five or more of the following:

1. Is uncomfortable in situations in which the center of attention is someone else
2. Interaction with others often characterized by inappropriate sexually seductive or provocative behavior
3. Displays rapidly shifting and shallow expression of emotions
4. Consistently uses physical appearance to draw attention to self
5. Has style of speech that is excessively impressionistic and lacking in detail
6. Shows self-dramatization, theatricality, and exaggerated expression of emotion
7. Is suggestible (ie, easily influenced by others or circumstances)
8. Considers relationships to be more intimate than they actually are

## KEY CONCEPTS

- Published in 1966, *Accidental Death and Disability: The Neglected Disease of Modern Society* by the National Academy of Sciences—National Research Council was instrumental in EMS maturation in the United States.
- There are multiple system designs for EMS systems, including public and private services, those operating at basic and advanced levels of care, and those that include single or multiple tiers of response capability.
- There are four levels of prehospital providers recognized nationally—emergency medical responder (EMR), emergency medical technician (EMT), advanced emergency medical technician (AEMT), and paramedic, which is the most advanced level.
- The community paramedic provider focusing on population health issues, such as access, chronic disease, and decreasing utilization, and readmission is now being considered by many communities.
- Advances in emergency medical dispatching and positioning resources at locations and during specified times where expected call volumes are prevalent are innovations that are being implemented to decrease response times and improve outcomes.
- Regulatory oversight for EMS systems lies at the individual state level, and medical direction for individual public or private services resides at the local level.
- Direct medical oversight involves real-time interaction with the prehospital providers via face-to-face or by radio communications. Indirect medical direction involves off-line processes such as protocol development, quality improvement, and education.
- Advances in prehospital care of medical patients have included analgesics and anxiolytics that can be administered intranasally negating intravenous routes, noninvasive measures to support patients in respiratory distress, alternative adjuncts in place of endotracheal intubation for managing airways, and tourniquets for controlling hemorrhage.
- More advanced diagnostics (such as, 12-lead electrocardiography and use of stroke screens) have assisted in transporting patients to appropriate facilities based on their illness and acuity.

## CHAPTER 190: QUESTIONS &amp; ANSWERS

**190.1.** Which of the following is not an Emergency Medical Treatment and Active Labor Act (EMTALA) requirement for patient transfer?

- A. Acceptance from receiving facility ensured
- B. Appropriate patient care data sent
- C. Appropriate transportation arranged
- D. Complete certification of transfer
- E. Medical or surgical stabilization

**Answer: E.** Box 190.1 provides a list of EMTALA requirements for patient transfer.

**190.2.** Which of the following is not included in the skill set of an advanced emergency medical technician (AEMT)?

- A. Cardiac rhythm recognition
- B. Endotracheal intubation
- C. Intravenous line placement
- D. Laryngeal mask airway
- E. Manual defibrillation

**Answer: A.** Cardiac rhythm recognition is in the authorized skill set of a paramedic. See Table 190.1.

**190.3.** Which of the following best defines Direct Medical Control in the prehospital setting?

- A. Concurrent direction of EMTs providing patient care
- B. Development of prehospital care policies
- C. Implement quality improvement program
- D. Use of prehospital patient care protocols
- E. Use of standing field treatment protocols

**Answer: A.** Direct medical control is the concurrent direction of EMTs providing patient care, which can be at the scene or online over radio or cell phone.

**190.4.** Public access defibrillation programs have been successful in all but which of the following locations?

- A. Airports
- B. Casinos
- C. Churches
- D. Office buildings
- E. Schools

**Answer: E.** Public access defibrillation programs have been successful in high-volume, populous areas where large numbers of adults gather; schools generally have younger persons who are relatively healthy, so public access defibrillation programs there have not been cost effective.

**190.5** Which of the following prehospital interventions has been shown to improve patient outcome?

- A. Defibrillation
- B. Endotracheal intubation for children
- C. Endotracheal intubation for severe head trauma
- D. Intraosseous needle placement
- E. Needle cricothyrotomy

**Answer: A.** Rapid defibrillation has been shown to improve outcomes for patients in cardiopulmonary arrest; other interventions have not shown proven benefit in the prehospital setting.

## KEY CONCEPTS

- Boyle's law and Dalton's law have the greatest impact and explain the development of hypoxia and most common altitude-related symptoms. Other stresses of flight that can affect the patient or crew include temperature fluctuations, dehydration, noise, and vibration.
- The helicopter emergency medical service (HEMS) industry continues to grow; however, the business models are changing with the majority of helicopters operated by privately owned or publically traded for-profit companies rather than non-profit hospitals.
- Although most flight programs do both primary (scene flights) and secondary (interfacility) response, ground ambulance remains the primary means of out-of-hospital and interfacility patient transport.
- The helicopter offers several advantages over other transport vehicles, including reducing travel time by up to 75%, ability to avoid common ground delays (traffic, obstacles, and so on), and ability to fly into locations that may be inaccessible to other modes of travel.
- All air medical services require involvement of a medical director responsible for supervising, evaluating, and ensuring the quality of medical care.
- As a general rule, helicopters are less useful in urban settings because of the proximity of health care facilities and a lack of open and safe landing zones.
- Helicopter emergency medical service (HEMS) represents the only modality by which nearly 28% of American residents have timely (within 1 hour) access to level I or level II trauma centers, and the research supports an improvement in trauma survival rates compared to ground transport.
- HEMS may benefit in other time-critical situations, including ST-elevation myocardial infarction (STEMI) patients going to a catheterization laboratory and acute stroke patients going to regional stroke centers.
- Safety is the predominant concern of air medical operations. The practice of a requesting EMS agency or hospital calling numerous HEMS programs after other programs have declined the flight because of bad weather, must be avoided.
- Essential considerations for landing zone safety are as follows: vehicles and personnel should be kept at least 100 ft from the landing zone; spectators should be kept at least 200 ft from the landing zone; helicopters should only be approached when signaled to do so by the pilot or an onboard crew member; never approach or depart from the rear of the helicopter; and if the aircraft is parked on a slope, approach and depart on the downhill side (greatest clearance under the blades).

## CHAPTER 191: QUESTIONS &amp; ANSWERS

**191.1.** Which of the following statements is true regarding air medical transport (AMT)?

- AMT improves outcomes when used for acute coronary syndrome (ACS) transport.
- AMT of neonates is associated with more frequent oxygenation/ventilation derangements than ground transit.
- AMT use after acute stroke is limited by emergency medical service (EMS) provider inaccuracy in stroke patient identification.
- Faster times to a trauma center are not required for outcomes benefit from AMT.
- Outcomes after AMT of high-risk obstetric cases are superior to those of patients presenting primarily.

**Answer: D.** Factors other than speed seem to be responsible for AMT benefit. No certain benefit for use during ACS has been demonstrated because most patients would benefit from thrombolysis at the outside hospital followed by advanced capability ground transportation. EMS personnel are able to identify stroke cases with reasonable accuracy. AMT transport of high-risk obstetric cases has outcomes equal to those of patients presenting primarily. Neonates do not suffer greater pulmonary derangements during or after AMT.

**191.2.** Which of the following statements is true regarding air medical transport (AMT)?

- If the patient's condition is severe, it is prudent to request service from several AMT providers in the face of marginal weather.
- Spectators should be kept at least 200 feet away from the landing zone.
- The pilot should be briefed on the patient's acuity.
- The use of a hospital helipad for emergency medical service (EMS) rendezvous triggers the Emergency Medical Treatment and Active Labor Act (EMTALA).
- Vehicles and personnel should be kept at least 50 feet away from the landing zone.

**Answer: B.** See [Box 191.1](#) for safety of personnel approaching and disembarking a helicopter. To maintain weather and equipment objectivity, the pilot has no need to know anything about the patient. "Helicopter shopping" between services is strictly discouraged by the Federal Aviation Administration (FAA). The use of a hospital helipad for EMS rendezvous does not trigger EMTALA for that hospital.

**191.3.** Which of the following statements is correct regarding the aviation physiology gas laws?

- Boyle's law explains the physiologic effects of expansion and contraction of gases within the closed spaces of the body that may occur with altitude change.
- Charles' law can be shown as  $P_t = P_1 + P_2 + P_3 \dots P_n$ .
- Dalton's law accounts for the gas changes that result in decompression sickness.
- Henry's law explains why the ambient temperature decreases with increased altitude.

**Answer: A.** Boyle's law states that the volume of a unit of gas is inversely proportional to the pressure on it. As altitude increases, atmospheric pressure decreases, the molecules of gas grow apart, and the volume of the gas in an enclosed space expands. On descent, there is an increase in atmospheric pressure and gas volumes contract. Dalton's law states that the total barometric pressure at any given altitude equals the sum of the partial pressures of gases in the mixture ( $P_t = P_1 + P_2 + P_3 \dots P_n$ ). Charles' law notes that as the volume of a unit of gas rises, the temperature of that volume falls and explains why the ambient temperature decreases with increased altitude. Henry's law states that the mass of gas absorbed by a liquid is directly proportional to the partial pressure of the gas above the liquid. Rapid ascent from depth causes the gas to come out of solution within the bloodstream, resulting in decompression sickness.

**191.4.** Which of the following statements is correct with regard to landing zone safety?

- During night operations, spotlights should be toward the approaching aircraft.
- If the aircraft is parked on a slope, approach and depart on the downhill side.
- In a rear-loading helicopter, it is safe to approach or depart from the rear of the helicopter.
- It is safe to approach the helicopter when signaled to do so by trained ground personnel.
- Vehicles and personnel should be kept at least 50 ft from the landing zone.

**Answer: B.** When the aircraft is parked on a slope, approach and depart on the downhill side where there is the greatest clearance under the blades. Vehicles and personnel should be kept at least 100 ft from the landing zone. Approach the helicopter only when signaled to do so by the pilot or an onboard crew member. Never approach or depart from the rear of any helicopter. Approach and depart the helicopter only forward of the rear cabin door. During night operations, spotlights should be directed at the top of possible hazards, not toward the approaching or departing aircraft.

## KEY CONCEPTS

- Comprehensive emergency management consists of four phases: mitigation, preparedness, response, and recovery.
- Mass casualty planning should account for the fact that traditional transport and communications systems will break down.
- Field personnel should be specifically trained in mass casualty triage and stabilization because austere field conditions change management strategies.
- All plans must protect caregivers and rescue personnel.
- Critical incident stress management may be highly desirable after an event and should be planned for in advance. Psychological triage tools, such as PsySTART, may help.
- Planners should establish and exercise a hospital-based incident management system.
- Disaster planning needs to include policies to address the needs of vulnerable populations, such as children, disabled, and the elderly.

## CHAPTER 192: QUESTIONS &amp; ANSWERS

**192.1.** Which of the following statements is true regarding applications of Secondary Assessment of Victim Endpoint (SAVE) triage guidelines?

- A. It is applicable to day-to-day hospital operations.
- B. Outcome expectations are theoretically based.
- C. Patients are sorted into one of four categories.
- D. The system provides detailed management of psychogenic cases.
- E. Triage decisions are based on field outcome expectations.

**Answer: E.** The SAVE system is designed specifically for care in an austere environment. It triages patients into (1) those who will die regardless of treatment, (2) those who will live regardless of treatment, and (3) those who would benefit from austere intervention. The triage decisions are based on field outcome expectations from existing survival and morbidity statistics.

**192.2.** Which of the following best describes the National Disaster Medical System (NDMS)?

- A. It does not include private sector institutions.
- B. It does not involve the Department of Veterans Affairs (VA).
- C. It is military based.
- D. The Department of Health and Human Services (DHHS) has oversight.
- E. The medical response element consists of Department of Defense (DoD) personnel.

**Answer: D.** The NDMS is a federally coordinated initiative that is a cooperative program between the DoD, VA, DHHS, and Department of Homeland Security (DHS) with oversight provided by DHHS. The NDMS provides a system of coordinated mutual aid agreements among federal, state, local, and private institutional entities for resource and personnel provision in times of disaster. The medical response element includes dozens of volunteer civilian medical teams that supplement the local medical infrastructure.

**192.3.** Which of the following statements is true regarding disaster response?

- A. Critical incident stress debriefing is best conducted 1 or 2 weeks after the event.
- B. Medical resupply systems are the most vulnerable component of a disaster plan.
- C. One of the Department of Veterans Affairs (VA) system's four legally mandated missions is emergency management.
- D. The Federal Emergency Management Agency (FEMA) has a coordinating responsibility for the entire spectrum of disasters.
- E. The Joint Commission mandates deal only with disasters within the hospital.

**Answer: C.** One of the VA health system's four mandated missions is emergency management. Although controversy exists, critical incident stress debriefing, if used, should be implemented as early as possible. The Department of Homeland Security (DHS) has full-spectrum disaster coordinating responsibility. Communications systems are likely the most vulnerable systems. The Joint Commission mandates deal with plans and preparations for disasters within the entire community as well as within the hospital.

**192.4.** Which of the following statements is *not* a feature of emergency management?

- A. During simple triage and rapid treatment (START) triage, two interventions may be performed: opening an airway and controlling external hemorrhage.
- B. Health care facilities should perform a hazard vulnerability analysis to assess community risks.
- C. PICE is a conceptual framework to describe disasters and stands for "potential injury-creating event."
- D. The four phases of comprehensive emergency management (CEM) are pre-event, event, post-event, and baseline.
- E. Worldwide morbidity and mortality from disasters is increasing, in part due to increases in population density.

**Answer: D.** The four phases of CEM are mitigation, preparedness, response, and recovery. These phases represent a continuum over time, and more than one phase may be in effect at the same time (eg, even during the response phases, recovery actions may take place.)

Systemic toxicity from mustard is caused by bone marrow suppression. Absorbed mustard kills stem cells, causing the white blood cell count to decline after 3 to 5 days. Survival is rare if the white blood cell count falls below 200, which generally occurs when more than 50% of the total body surface area is involved from exposure to liquid agent. Death after mustard exposure usually results from secondary infection and respiratory failure.

## Cyanides (Blood Agents)

### Principles

Cyanide molecules, most typically hydrogen cyanide or cyanogen chloride, bind to cytochromes within mitochondria and inhibit cellular oxygen use.

### Clinical Features

Low-dose exposures result in tachypnea, headache, dizziness, vomiting, and anxiety. Symptoms subside when the patient is removed from the source. At higher doses, the symptoms progress

to seizures, respiratory arrest, and asystole within minutes of exposure.

### Management

Victims should be removed from the area, have their clothing discarded, and receive oxygen. If no improvement occurs, the cyanide antidote is given. This has traditionally been the sequential administration of amyl nitrate, sodium nitrite, and sodium thiosulfate. However, the FDA has approved intravenous hydroxocobalamin for treatment of cyanide exposure. The initial dose is 5 g and can be repeated if necessary.<sup>13-15</sup>

## Pulmonary Intoxicants (Phosgene and Chlorine)

Pulmonary or choking agents cause an inflammatory reaction when they come into direct contact with the eyes and upper airway. They can be life-threatening if inhaled. No specific antidote exists. Treatment is mainly supportive and consists of removal of the patient from the source, decontamination, airway maintenance, bronchodilator administration, and eye irrigation.



## KEY CONCEPTS

- Emergency department (ED) preparedness for a radiation incident should address decontamination (an external freestanding decontamination unit is best), triage, staff safety, personal protective equipment (PPE), and diagnostic procedures that emphasize radiation monitoring. It is important that emergency personnel know their radiation safety officer.
- Management of acute life-threatening conditions takes priority over radiation-associated issues.
- Aerosol dispersal is a likely route that terrorists may use to deploy biologic weapons, so victims will present primarily with respiratory complaints.
- In addition to “flu-like” symptoms, anthrax typically causes mediastinal widening, pulmonary consolidation, and pleural effusions best seen on chest computed tomography (CT) scans.
- Smallpox can spread in a hospital environment; thus patients thought to have smallpox should be admitted to locations separated from the rest of the hospital.
- Decontamination is a key activity in the management of patients exposed to chemical agents, and hospitals should provide this intervention.
- Nerve agents are organophosphates, and patients exposed to these agents are treated with large doses of atropine (repeated frequently), pralidoxime, and benzodiazepines.

## CHAPTER 193: QUESTIONS &amp; ANSWERS

**193.1.** Three patients arrive at triage simultaneously: One has received a 4 Gray work-related irradiation exposure from a food sterilizer but no other injury, one is experiencing an acute ST elevation myocardial infarction (MI), and one likely has urosepsis but with a stable blood pressure and heart rate of 105 beats/min. Which of these patients should receive your attention first?

- Activate the cardiac catheterization team.
- Decontaminate the irradiated victim before placing him in a room.
- Initiate intravenous (IV) fluid bolus and prepare for intubation of the radiation-exposed patient.
- Place a central venous catheter in the urosepsis patient.
- Place the irradiated victim in an isolation room.

**Answer: A.** Even patients who have received a lethal radiation dose do not die quickly as a consequence of the ionizing exposure. Patients should still be triaged according to severity of the medical conditions and/or vital sign derangements. Here, the patient with the MI is most acute and should be treated first by activating the cardiac catheterization team. The radiation-exposed patient was not contaminated, just irradiated. As such, decontamination and isolation are not necessary. Although the victim has received the LD<sub>50/60</sub> dose of ionizing radiation, no significant injury will result just after exposure, so this patient does not take priority over the MI patient at this point and intubation is not indicated. The septic patient is not critically ill and should not be treated ahead of the MI patient.

**193.2.** Which of the following statements best describes issues in management of anthrax infection?

- Antibiotics do not change the mortality of cutaneous disease.
- Cutaneous anthrax lesions are nontender.
- Doxycycline or ciprofloxacin is the single-agent treatment for symptomatic inhalational anthrax.
- Intubation/mechanical ventilation clearly improves mortality from inhalational anthrax.
- Sputum culture and Gram's stain obtained early in the disease help differentiate inhalational anthrax.

**Answer: B.** Cutaneous anthrax causes a severe, although nontender, peripheral vesicle and then eschar with regional adenopathy. Antibiotics lower the mortality from cutaneous anthrax

twentyfold. For inhalational, gastrointestinal, and cutaneous anthrax with toxicity, intravenous (IV) treatment is with ciprofloxacin or doxycycline plus at least two other agents. Regarding inhalational anthrax, mechanical ventilation may not improve mortality, and sputum cultures and Gram's stains are not helpful until late in the disease.

**193.3.** Several children ages 5 to 8 years old have definitely been exposed to anthrax spores. Health department officials have brought these children to the emergency department (ED). They are all ambulatory with normal vital signs and without symptoms. Which of the following is the most appropriate management?

- Admission for parenteral penicillin G
- Doxycycline for 5 days
- Observation
- Outpatient ciprofloxacin for 60 days or until the children have received three doses of vaccine
- Penicillin VK for 7 to 10 days

**Answer: D.** See [Box 193.5](#). For children without toxicity, ciprofloxacin, doxycycline, or amoxicillin orally is indicated for a minimum of 60 days or until the child has received three doses of vaccine. The vaccine has not been approved for children but may be indicated to reduce the long-term exposure to antibiotics. Note that weaponized anthrax may be penicillin resistant.

**193.4.** An individual is exposed to sarin vapor. She presents complaining of difficulty with vision, salivation, vomiting, and the urge to defecate. The most appropriate treatment for this patient is which of the following?

- 5 mg diazepam intravenous (IV)
- 6 mg atropine IV and 1 g 2-PAM IV every hour for a total dose of 3 g
- 10 mg diazepam intramuscular (IM) via auto-injector
- Observation for 6 hours and then discharge if she does not develop new symptoms
- One or two Mark 1 kits IM

**Answer: E.** The victim described would be characterized as a moderate exposure to sarin vapor. As such, treatment is indicated with one or two Mark 1 auto-injectors IM. Observation would not be appropriate. Diazepam is not indicated for moderate exposures. If an IV is established, the initial treatment is atropine 2 to 4 mg IV and 2-PAM 1 g IV.

## KEY CONCEPTS

- Knowledge of wound mechanics and production, as well as wound appearance, can provide practicing emergency clinicians with important clues regarding the forensic interpretations of injuries.
- Wounds and injuries should be diagrammed and photographed.
- The medical record should accurately document objective findings associated with a patient's wounds. Emergency clinicians should not speculate about their mechanism or the cause.
- Any evidence collected during the course of treatment must be documented in the medical record, including to whom the evidence was given, for the chain of custody to be preserved.

## CHAPTER e1: QUESTIONS &amp; ANSWERS

- e1.1.** When documenting a gunshot wound, it is important to do which of the following?
- Describe the appearance, physical characteristics, and location of wounds.
  - Describe the bullet trajectory.
  - Determine the type of bullet used.
  - Estimate the caliber of the bullet.
  - Interpret the wounds as “entrance” or “exit.”

**Answer: A.** Emergency clinicians should not identify wounds as “entrance” or “exit.” Instead, their charting should include a detailed description, using appropriate forensic terminology, of the wound's characteristics and location without speculating about its function or the caliber or type of bullet (projectile) used to create it.

- e1.2.** A young woman presents with a gunshot wound to her arm. She has good pulses and sensation distal to the wound. On inspection of the wound, you notice a black material, which can be wiped away, surrounding the wound. This most likely indicates which of the following?
- The barrel of the gun was between 12 and 24 inches (intermediate range) away.
  - The barrel of the gun was within 6 inches (close range) of the skin.
  - The distance between the barrel of the gun and the skin cannot be determined.
  - The patient was initially wearing a dark shirt.
  - This is an exit wound.

**Answer: B.** In close-range wounds (6 inches or less), the carbonaceous material created from the burning of gunpowder will deposit on skin and clothing. The carbonaceous material is called soot and can be easily wiped away from wounds.

- e1.3.** Tattooing, associated with a gunshot wound of entrance, is pathognomonic for which of the following?
- Close-range wound
  - Contact wound
  - Distant-range wound
  - Indeterminate-range wound
  - Intermediate-range wound

**Answer: E.** Tattooing, or stippling, is pathognomonic for an intermediate-range gunshot wound. It appears as punctate abrasions and is caused by contact with partially burned and wholly unburned pieces of gunpowder. Tattooing or stippling cannot be wiped away and will gradually resolve over several days. Intermediate range is defined as 48 inches or less.

- e1.4.** A 23-year-old woman presents after having been physically and sexually assaulted by an unknown assailant. In addition to multiple abrasions and brown contusions, she has a bite mark on her left shoulder. Which of the following is not appropriate in your evidence collection procedures and evaluation of this patient?
- Estimating the age of the contusions based on their color
  - Measuring and documenting each visible injury on a diagram
  - Preserving the condition of the bite mark until after a forensic examination
  - Swabbing the bite mark with a sterile cotton-tipped applicator moistened with sterile water or saline
  - Taking photographs of the bite mark and each injury

**Answer: A.** When an acute bite mark is identified, take care that critical evidence is not washed away. The skin surface should first be swabbed with a sterile cotton-tipped applicator moistened with sterile saline. Swabbing the area may reveal the assailant's DNA present in dried saliva. Remember, a contusion's color is never a predictor of its age. The emergency clinician may be asked to render an opinion regarding the age of a contusion. Because contusions develop as a result of multiple variables, there is no reproducible standard for dating them.

- e1.5.** When managing a gunshot wound victim, which of the following is not important for forensic evidence collection?
- Do not clean the hands with alcohol or Betadine.
  - If soot is noted on the hands of the victim, cover with paper bags.
  - Maintain a chain of evidence.
  - Place each article of clothing in a separate paper bag.
  - Use metal forceps to handle a bullet to prevent contamination.

**Answer: E.** Never remove a bullet with metal hemostats or pickups because metal tools can obliterate the microscopic markings (the telltale fingerprint) of the gun from which it was shot. A victim's clothing may hold the answer to critical questions, such as “How far away was the assailant who fired the weapon?” and “Which hole is the entrance and which the exit?” Articles of clothing removed from a wounded patient should be placed in separate paper bags to preserve the trace evidence on them and to avoid accidentally transferring evidence from one article to another (cross-contamination). Always cover a patient's hands with paper bags when the presence of soot is suspected. A gunshot residue test may determine whether a victim or suspect has been in close proximity to a weapon that has been fired. Factors that decrease the sensitivity of gunshot residue tests include washing the skin with alcohol or Betadine.

## KEY CONCEPTS

- The Haddon Matrix addresses injury prevention by focusing on the environment, agent inflicting harm, and at-risk populations. Key tenets to this injury prevention model include understanding of the following: (1) injuries are predictable; (2) they follow typical patterns (eg, by age or gender); and (3) reliance solely on human factors for prevention has significant limits.
- The E-code is a system for identifying the cause of injury according to the International Classification of Diseases, Clinical Modification, and allows for systematic tracking of harmful agents.
- Proper use of lap and shoulder belts reduces the risk of death and severe injury to front seat passengers by 50%.
- Ten percent of fatal motor vehicle collisions and 17% of injury collisions are associated with distractions.
- Hospital-based violence intervention programs have been shown to decrease recidivism to the emergency department for recurrent violent injuries and decrease recidivism to the criminal justice system; hospital-based violence intervention programs have been found to be cost-effective.
- Firearm related injuries are more prevalent among countries with higher rates of gun ownership. The US has the highest rate gun ownership, with 89 guns/100 persons and the highest mortality rate attributed to firearm injuries of developed countries (eg, 40 times higher than that of the UK).

## CHAPTER e2: QUESTIONS &amp; ANSWERS

- e2.1. What percentage of injured patients seen in an emergency department are treated and discharged rather than admitted?
- 59%
  - 65%
  - 76%
  - 88%
  - 98%

**Answer: D.** Approximately 88% of injured patients seeking medical care for injury are treated and discharged from the emergency department.

- e2.2. What is the E code?
- A system for identifying the cause of injury in a patient's medical record
  - A system for identifying the severity of injury in a patient's medical record
  - A system for indicating the type of injury in a patient's medical record
  - A system for predicting morbidity secondary to trauma in a patient's medical record
  - A system for predicting mortality secondary to trauma in a patient's medical record

**Answer: A.** The most crucial data element for the understanding of injury is the E code, a system for identifying the cause of injury

in a patient's medical record, according to a classification published in the *International Classification of Diseases*. The "E" stands for external cause of injury, such as a motor vehicle collision, fall, or bicycle collision.

- e2.3. Alcohol-related motor vehicle collisions account for what percentage of motor vehicle collision fatalities?
- 7%
  - 19%
  - 31%
  - 68%
  - 87%

**Answer: C.** Alcohol-related collision injury is a national epidemic in the United States, accounting for 31% of all motor vehicle collision fatalities.

- e2.4. What percentage of violent injuries can be attributed to patients with a major mental health diagnosis?
- 4%
  - 24%
  - 44%
  - 84%

**Answer: A.** Only 4% of violent injuries are attributed to people with a major mental health diagnosis. The vast majority of patients with mental illness will never be violent.

## KEY CONCEPTS

- A humanitarian emergency, or humanitarian crisis, is a critical threat to the health, safety, security, or well-being of a community or other large group of people, usually over a wide area.
- Demand for humanitarian responders is likely to rise in the future as global urbanization and an increase in climate-related disasters conspire to create more frequent and severe disasters. At the same time, the growing professionalization of humanitarian aid will move the field closer to a model of international standards and cooperation among relief agencies.
- Humanitarian responders should understand the organizational strengths and weakness of the nongovernmental organization (NGO) and the setting, mission, and likely hazards associated with the deployment.
- Emergency clinicians have a skill set well suited for humanitarian response. Those who seek appropriate training and experience will have the opportunity to expand their professional practice while providing an essential service to the world's most vulnerable populations.

## CHAPTER e3: QUESTIONS &amp; ANSWERS

**e3.1.** A health crisis exists in a refugee population when the crude mortality rate (CMR) reaches how many times the baseline CMR?

- A. 1.5
- B. 2.0
- C. 3.0
- D. 5.0

**Answer: B**

**e3.2.** Which of the following medical responses is the highest priority in a nation with an underdeveloped health care infrastructure after a natural disaster causing mass population displacement into temporary shelters?

- A. Immediate construction of temporary hospitals with surgical capability
- B. Implementation of hand hygiene education programs
- C. Rapid deployment of emergency surgical teams
- D. Rapid initiation of measles vaccination campaign

**Answer: D**

**e3.3.** The *Sphere Handbook* provides what information for aid agencies?

- A. Comprehensive catalogue of nongovernmental agencies' response capabilities for humanitarian crises
- B. Most current set of standards for establishing and managing an Ebola treatment unit
- C. Single set of uniform standards for aid agencies to follow in humanitarian response
- D. Standardized approach to resolving ethical challenges in humanitarian crises for emergency clinicians

**Answer: C**

**e3.4.** For what activities should emergency clinicians deploying to a humanitarian crisis generally be expected to prepare?

- A. Assist in the care of a large number of emergency surgical patients.
- B. Gain experience practicing outside of one's usual scope of practice.
- C. Provide care for a large number of chronically malnourished patients.
- D. Provide mostly primary care and assist in restoration of basic health services.

**Answer: D**

## KEY CONCEPTS

- Tactical emergency medical support (TEMS) facilitates the overall success and safety of law enforcement missions during all phases of a tactical operation through the delivery of preventive, urgent, and emergency medical care.
- A fundamental principal in tactical medicine is that the medical mission may be subordinate to the overall law enforcement mission.
- Tactical combat casualty care (TCCC) has adapted civilian advanced life support principles to provide medical care during an effective hostile force encounter. Its goals are to treat the casualty, prevent additional casualties, and complete the mission.
- TCCC is divided into three phases of care—care under fire (CUF), tactical field care (TFC), and combat casualty evacuation care (CASEVAC).
- Tactical emergency casualty care (TECC) addresses casualty management during high-threat civilian tactical and rescue operations and is divided into three phases; direct threat, indirect threat, and evacuation care.
- Urban search and rescue (USAR) is the science of responding to, locating, reaching, medically treating, and safely extricating victims entrapped by collapsed structures. The primary role of the emergency clinician is support of the health and welfare of the team members, including canines.
- USAR teams often treat crush syndrome, particulate inhalation, hazardous materials exposures, and blast injuries.
- In crush syndrome, treatment with fluids begins prior to extrication to avoid life-threatening complications once the patient is extricated.

## CHAPTER e4: QUESTIONS &amp; ANSWERS

**e4.1.** Which of the following is a priority for the tactical emergency medical support (TEMS) provider in caring for a victim shot during a hostage incident?

- A. Bag-valve-mask ventilation
- B. Cervical spine stabilization
- C. Endotracheal intubation
- D. Intravenous access and fluid resuscitation
- E. Tourniquet application to bleeding extremity

**Answer: E.** This scenario describes care rendered by TEMS in the hot zone, or care under fire; thus, conventional care sequences do not apply. Priorities include mitigation of threats, tourniquet use for serious bleeding, and evacuation to a safer location.

**e4.2.** A 28-year-old man has been trapped under building debris for 6 hours following an urban explosion. A rescue team is actively working to extricate him. Both legs are pinned, but his torso is free. Which of the following statements is true?

- A. Aggressive fluid therapy should begin after extrication.
- B. Assessment for crush injury should occur after 2 hours of immobilization.
- C. Cardiac monitoring is indicated during extrication.
- D. Prophylactic calcium is indicated.
- E. The incidence of acute renal failure is approximately 30%.

**Answer: C.** The incidence of crush injury rises dramatically after 4 hours of immobilization. Continuous cardiac monitoring is indicated during extrication. Calcium is indicated only for refractory arrhythmias or documented hypocalcemia. Fluid resuscitation may help prevent the hypotension associated with release of the entrapped limb(s) and should be initiated before extrication. The incidence of acute renal failure is 50% with one-extremity and 75% with two-extremity crush injuries (Japanese earthquake victim data).

**e4.3.** The principles of TEMS have largely developed from which type of incidents?

- A. Civilian multicasualty events
- B. Military conflicts
- C. Natural disasters
- D. Pandemics

**Answer: B.** The principles of TEMS have largely developed from lessons learned during military conflicts and most closely emulate the medical support structure of military special operations units.

**e4.4.** Which of the following is incorrect with respect to the principles of tactical medicine?

- A. During a tactical operation, TEMS providers may be directed to delay medical care.
- B. During a tactical operation, medical care of a casualty may jeopardize the overall mission.
- C. None of these.
- D. The first priority is always the health and welfare of the patient.
- E. The medical mission may be subordinate to the overall law enforcement mission.

**Answer: E.** A fundamental principal in tactical medicine is that the medical mission may be subordinate to the overall law enforcement mission. In contrast to conventional EMS and hospital practices, in which the sole priority is usually the health and welfare of the patient, the essential priority in a tactical mission is the success of the law enforcement objective. When a casualty occurs during a tactical operation, medical providers may be directed to delay or modify medical care until the tactical commander determines that rendering care will not jeopardize the overall mission.

**e4.5.** Which of the following is a primary responsibility of the USAR team emergency clinician?

- A. Extrication of victims
- B. Medical treatment of entrapped victims
- C. Locating victims
- D. Support the health and welfare of team members

**Answer: D.** The USAR team emergency clinician has a primary responsibility to the team members should they require medical attention.



## KEY CONCEPTS

- Emergency ultrasound is performed and interpreted by the emergency clinician at the bedside.
- Emergency ultrasound is designed to answer focused clinical questions.
- The key to proficiency in emergency ultrasound is practice.
- Credentialing guidelines exist to guide emergency clinicians in the acquisition of this important skill.
- All emergency clinicians should be familiar with the resuscitative applications of emergency ultrasound, including focused assessment with sonography for trauma (FAST), focused cardiac ultrasound, abdominal aortic aneurysm assessment, and procedural guidance for central venous catheter placement.
- The “four Is” of emergency ultrasound are as follows: (1) identification of appropriate patients for whom emergency ultrasound is likely to be valuable; (2) image acquisition; (3) interpretation of the acquired images; and (4) integration of the ultrasound findings into patient management.

## CHAPTER e5: QUESTIONS &amp; ANSWERS

**e5.1.** Emergency ultrasound (US) is defined by the physical location of the emergency patient.

- A. True
- B. False

**Answer: B.** Emergency US is not defined by location but by patient need. Patients may be in remote locations, prehospital, in the emergency department (ED), in the intensive care unit (ICU), or elsewhere in the hospital.

**e5.2.** Which are not typically involved with emergency US examinations?

- A. Acute symptom
- B. Comprehensive mapping of an organ
- C. Emergency sign
- D. Focused area of the body
- E. Physiologic pattern

**Answer: B.** Comprehensive mapping of organs is not typical of emergency US examination. The other items are characteristics of US done for emergency and symptom-based examinations.

**e5.3.** Which frequency range defines US?

- A. Less than 0.2 Hz
- B. Over 2 Hz
- C. Over 200 Hz
- D. Over 20,000 Hz
- E. Over 2 million Hz

**Answer: D.** US is defined as sound with frequency over 20,000 Hz.

**e5.4.** Which of the following performance characteristics is true for higher frequency probes?

- A. Deeper penetration, higher resolution
- B. Deeper penetration, poorer resolution
- C. Superficial penetration, higher resolution
- E. Superficial penetration, poorer resolution

**Answer: C.** Higher frequency probes penetrate in superficial areas but generally give good resolution.

**e5.5.** Which type of US has the best resolution when the probe is perpendicular to the object of interest?

- A. Doppler US
- B. Gray scale US

**Answer: B.**

**e5.6.** Which of the following is not considered safe practice for performing emergency US?

- A. Cleaning surface probes with spray or wipe
- B. Imaging over a body part continuously for 60 minutes

C. Special endovaginal cleaning

D. Use of the ALARA (*as low as reasonably achievable*) principle

E. Transducer covers during sterile procedures

**Answer: B.** There are thermal effects to US over a long duration.

**e5.7.** Which of the following areas is not scanned during an EFAST examination?

- A. Orbital space
- B. Pericardial space
- C. Peritoneal space
- D. Pleural space

**Answer: A.** Orbital space is not typically part of the EFAST.

**e5.8.** Sensitivity is typically greater than specificity for FAST examination.

- A. True
- B. False

**Answer: B.** The FAST examination is typically more specific than sensitive.

**e5.9.** Which of the following is the most appropriate use for emergency pelvic US in early pregnancy?

- A. To rule out adnexal masses
- B. To rule out ectopic pregnancy
- C. To rule out fibroids
- D. To rule in intrauterine pregnancy

**Answer: D.** The most appropriate use of US is to rule in intra uterine pregnancy, which greatly decreases the chances for an ectopic pregnancy. Evaluation of the adnexa and detection of an ectopic pregnancy requires a higher level of equipment and training than reliably available in an emergency situation.

**e5.10.** Which of the following is an advantage of endovaginal US over using a transabdominal window?

- A. Better ability to assess Morison's pouch
- B. Deeper penetration of ultrasound
- C. Greater field of view
- D. Higher resolution for assessment of gestational structures

**Answer: D.** An endovaginal transducer allows imaging closer to the structures of interest and eliminates poor acoustic imaging due to body habitus or artifacts such as bowel gas.

- e5.11.** Which of the following is not a typical use of cardiac US by emergency clinicians?
- A. Focal wall motion abnormalities
  - E. Global left ventricular function
  - C. Pericardial effusion
  - B. Pseudo-PEA (pulseless electrical activity)
  - D. Right ventricular dilation

**Answer: A.** Focal wall motion abnormalities are more difficult to detect than the other conditions.

- e5.12.** Which of the following has been demonstrated with the use of cardiac US?
- A. Reduced time to central line in sepsis
  - B. Reduced time to computed tomography (CT) in blunt obstetric trauma
  - C. Reduced time to operating room (OR) for penetrating cardiac trauma
  - D. Reduced time to pelvic fixator in blunt pelvic trauma

**Answer: C.** Emergency cardiac US has been shown to reduce time to the OR for penetrating cardiac trauma and has greatly decreased the need for emergency thoracotomy in critical patients.

- e5.13.** Which of the following is not an indication for emergency US of the abdominal aorta?
- B. Detecting aortic dissection
  - C. Detecting aortic occlusion
  - D. Placing aortic stents
  - A. Ruling out abdominal aortic aneurysm (AAA)

**Answer: D.** Ultrasound of the aorta is sensitive to detect AAAs and can rule out the condition with high accuracy. It is also useful to detect dissection and occlusion, but emergency clinicians do not place aortic stents.

- e5.14.** Which of the following is a typical use for biliary US by emergency clinicians?
- A. Biliary stricture
  - B. Gallstones
  - C. Hepatic cyst detection
  - D. Hepatic hemangioma

**Answer: B.** Gallstones are a common finding that can direct emergency management and disposition. The other conditions are not easily detected and do not need to be diagnosed on an emergency basis.

- e5.15.** Which of the following is not a characteristic of sonographic cholecystitis?
- A. Gallbladder septation
  - B. Gallbladder wall thickening
  - C. Gallstones
  - D. Pericholecystic fluid

**Answer: A.** All the findings provide evidence for cholecystitis except septation of the gallbladder.

- e5.16.** Dilation of which genitourinary (GU) structure(s) is typically seen with US?
- A. Bladder
  - B. Midureter
  - C. Renal calyces
  - D. Renal pelvis

**Answer: B.** Midureter

- e5.17.** A typical emergency lower extremity deep venous thrombosis (DVT) protocol includes compression of which of the following veins?
- A. Common femoral
  - B. Deep peroneal
  - C. Posterior tibial
  - D. Transcapular

**Answer: A.** Compression of the common femoral vein assists in the diagnosis of DVT.

- e5.18.** Which of the following is the correct order of imaging for the sensitivity of detecting a pneumothorax?
- A. Chest x-ray (CXR) > CT > US
  - B. CT > CXR > US
  - C. CT > US > CXR
  - D. US > CT > CXR

**Answer: C.** CT > US > CXR is the correct order.

- e5.19.** Which of the following is not a common abnormal pattern detected by lung US?
- A. Anechoic collection in the dependent pleural space
  - B. B-lines in the bases of the lung
  - C. Increased B-lines in the apices of the lung
  - D. Lack of sliding after penetrating chest trauma
  - E. Liver-like lesions with air bronchograms

**Answer: B.** B-lines in the bases of the lung are not common.

- e5.20.** Which of the following can be diagnosed by ocular ultrasound?
- A. Glaucoma
  - B. Pterygium
  - C. Retinal detachment
  - D. Uveitis

**Answer: C.** Retinal detachment can be seen on ocular ultrasound. US is not useful for the detection of the other conditions listed.

- e5.21.** Which of the following is not true of soft tissue US in the ED?
- A. US aspiration is superior to incision and drainage (I&D) in regard to resolution at 1 week.
  - B. US changes management of clinical cellulitis in 50% of adult patients.
  - C. US is more sensitive and specific than clinical examination.
  - D. Water baths may assist in the detection of superficial foreign bodies.

**Answer: A.** I&D is superior to US-guided aspiration in regard to abscess resolution at 1 week. The other statements are true.

- e5.22.** Which of the following has not been diagnosed by musculoskeletal US in the ED?
- A. Cervical disk impingement
  - B. Fracture of long bones
  - C. Hematomas
  - D. Joint effusions
  - E. Tendon lacerations

**Answer: A.** Musculoskeletal US has been used for all the listed conditions except cervical disk impingement.

**e5.23.** Dynamic US guidance reflects sonographic real visualization of the needle tip into the particular anatomic region.

- A. True
- B. False

**Answer: A.** True

**e5.24.** During a US-guided procedure, which of the following is not a benefit of the long-axis approach to US guidance?

- A. Depth information
- B. Medial-lateral information
- C. Visualization of the needle shaft tip
- D. Visualization of the needle tip

**Answer: B.** Medial-lateral information is lacking because the plane of the US is aligned with the needle.

**e5.25.** Which of the following procedures is benefited by US guidance?

- A. All of these
- B. Arthrocentesis
- C. Internal jugular guidance
- D. Pericardiocentesis
- E. US-guided nerve blocks

**Answer: A.** All the listed procedures benefit from US guidance.

**Video e5.1.** Pericardial effusion with tamponade. This subcostal cardiac view demonstrates a large circumferential pericardial effusion, with diastolic collapse of the right ventricle.

**Video e5.2.** Normal lung sliding. The hyperechoic pleural line is sliding normally in an interspace between two ribs.

**Video e5.3.** Absent lung sliding. The pleural line is visualized between two ribs but does not demonstrate normal sliding movement.

**Video e5.4.** Internal jugular vein, located anterior to the carotid artery, with normal compressibility.

**Video e5.5.** Internal jugular vein cannulation. During dynamic ultrasound-guided central line placement, the hyperechoic needle with a ring-down artifact is visualized in the internal jugular vein. Care must be taken to visualize the needle tip at all times to avoid posterior wall or carotid puncture.

## KEY CONCEPTS

- Hospitalization can often be avoided by providing short-term care (<24 hours) in observation units for certain medical disorders, such as chest pain, deep vein thrombosis (DVT), upper gastrointestinal (GI) bleeding, syncope, transient ischemic attack (TIA), trauma, asthma, atrial fibrillation, congestive heart failure (CHF), dehydration, pneumonia, and pyelonephritis.
- The use of observation units results in cost savings and improved patient satisfaction with care.
- Observation care is on an outpatient basis and is not necessarily delivered in a specific location.
- Observation is used to provide additional time for therapeutics and/or diagnostics for patients with an uncertain need for inpatient admission.
- Observation care is often influenced by payer policies and is congruent with recent national efforts to increase patient safety while also reducing unnecessary costs.
- Evidence-based observation care is delivered in a dedicated area for this purpose, using condition- or complaint-specific protocols of care.
- When used appropriately and at benchmark levels of quality and efficiency, observation visits can reduce the duration and thus the cost of hospital care for eligible patients while also reducing the incidence of unsafe discharges to home.
- The role of observation care is best studied in chest pain patients but, over the past several decades, patients with many other conditions have shown to be managed effectively using observation.
- Emergency clinicians should play a central role in identifying and managing observation patients.

## CHAPTER e6: QUESTIONS &amp; ANSWERS

**e6.1.** Which of the following is not a high risk factor for adverse events or death in patients with a syncopal event?

- A. Abnormal electrocardiogram (ECG)
- B. Advancing age
- C. Female gender
- D. History of heart failure
- E. History of ventricular dysrhythmia

**Answer: C.** Female gender is not included in the factors to be considered in the risk stratification of patients for consideration of referral to outpatient observation for further evaluation and management of patients with syncope (see [Box e6.4](#)).

Additional factors that would indicate a patient is unsuitable for observation to evaluate their syncope episode include those who have a history of dyspnea, loss of consciousness for more than 10 minutes, trauma or seizure, past history of chronic obstructive pulmonary disease (COPD) or structural heart disease, abnormal laboratory results—hematocrit level < 30%, elevated brain natriuretic peptide (BNP) or ProBNP level, positive cardiac or abnormal electrolyte levels—electrocardiographic evidence of injury or ischemia, documented or highly suspected unstable dysrhythmia, low oxygen saturation or unstable vital signs, stool positive for blood, new focal neurologic findings or persistently altered mental status, and/or high or moderate probability of serious dangerous disease or adverse event.

**e6.2.** Which of the following criteria, when present in a patient with chest pain and a nondiagnostic electrocardiogram (ECG), is consistent with the decision to refer a chest pain patient to outpatient observation rather than admission to the acute care hospital?

- A. Blunt chest trauma preceding pain
- B. Cocaine-induced chest pain
- C. History of three-vessel coronary artery bypass grafting (CABG)
- D. Minimal elevation in troponin
- E. Recurrent chest pain

**Answer: B.** Patients with a low risk of acute myocardial infarct (AMI) are candidates for referral to an outpatient chest pain observation unit rather than admission to the acute care hospital. Patients considered appropriate for placement in an outpatient chest pain observation unit include those with nontraumatic chest pain, low probability of disease or risk of adverse event, stable vital signs, normal cardiac biomarkers, and nondiagnostic ECG. Patients with cocaine-induced chest pain who meet the previous criteria may also be appropriately evaluated in a chest pain unit. Patients unsuitable for observation unit evaluation include those who have evidence of moderate to high risk, as shown by diagnostic electrocardiographic changes, positive cardiac biomarkers, clinical evidence of moderate or high probability of serious dangerous disease or risk of adverse event, continuing chest pain, and/or unstable vital signs.

**e6.3.** Which of the following parameters by itself makes inpatient admission the recommended emergency department (ED) disposition of a patient with the diagnosis of pneumonia?

- A. Age > 65 years
- B. Arterial pH < 7.35
- C. Presence of congestive heart failure
- D. Presence of neoplastic disease
- E.  $\text{Sao}_2$  less than 90%

**Answer: E.** See [Table e6.1](#) for the Pneumonia Severity Index scoring system for admission decisions. Oxygenation is the first step in determining risk and hypoxia, regardless of any other findings, justifies inpatient care.

**e6.4.** All the following clinical scenarios are suitable candidates for ED observation unit admission except which one?

- A. Atrial fibrillation with new onset of acute on chronic congestive heart failure
- B. Chest pain with low probability of serious disease or adverse event
- C. Congestive heart failure with BNP level of 400 pg/mL
- D. Dehydration with moderate electrolyte abnormalities
- E. Hyperemesis gravidarum

**Answer: A.** All the choices are acceptable observation candidates except for atrial fibrillation, with new onset of acute on chronic congestive heart failure. See [Box e6.6](#) for observation criteria for new-onset atrial fibrillation.

## KEY CONCEPTS

- Changing demography and an evolving culture in the United States is changing emergency medicine practice.
- Disparities in health and health care delivery continue, despite efforts to improve care. Emergency clinicians and their institutions will need to be part of the solution—treating preventable conditions that become crises because of reduced access to primary care and specialists and acting as advocates for strategic system change to eliminate disparities in their institutions.
- Emergency departments (EDs) will contribute to breaking cycles of illness if they seize opportunities to establish treatment plans and interventions that focus on social determinants of health, health literacy, and empowerment of patients to participate in their care.
- Treatment plans that are created with patients and are based in what matters to them have the greatest opportunity for success.
- Emergency clinicians will improve the quality of care provided if they can meet federal standards for culturally and linguistically appropriate care, recognizing that patients with limited English proficiency have a right to medical interpretation.
- Culturally sensitive, patient-centered, and trauma-informed care will improve patient–emergency clinician communication and satisfaction, decrease medical errors, and promote patient follow-through with recommendations.

## CHAPTER e7: QUESTIONS &amp; ANSWERS

- e7.1. Which of the following factors has not been identified as a health care disparity for minorities?
- High rates of no insurance or underinsurance
  - Lack of prenatal care
  - Likelihood of living in an area with adequate physician concentration
  - Lower life expectancy when compared to white populations
  - Relatively low number of minority providers

Answer: C

- e7.2. Patients' cultural perceptions can have significant impact on how they perceive their provider and the care they are receiving. Which of the following methods can be used by providers to approach different cultural perceptions so as to enhance the provider-patient relationship?
- Being aware of one's own cultural values
  - Developing assumptions of cultural perceptions based on patients' ethnicity or race
  - Limiting participation of alternative therapies and folk medicine in the patient's care plan
  - Maintaining the role of the physician as the decision maker, even when it may conflict with the patient's autonomy

Answer: A

- e7.3. A helpful language translator can be essential in communication with a patient who is facing a language barrier. Which of the below methods are recommended for using an interpreter during a medical examination?
- Asking the patient to have friends or family translate discharge instructions for them
  - Maintaining easy access to trained medical interpreters
  - Only obtaining an interpreter if the patient requests it
  - Using a family member is appropriate as long as they are older than 18 years
  - Using health care staff members who are fluent in the patient's language

Answer: E

- e7.4. Which of the following is not a benefit of using trauma-informed care when interacting with victims of violence?
- Decreased need for pain medications
  - Decreased risk of injury or re-injury
  - Decreased risk of long-term psychological sequelae related to patient's injury
  - Improved patient understanding of posttraumatic behavior

Answer: A

- e7.5. Which of the following recommendations was not made by the Institute of Medicine to aid in decreasing disparities in health care?
- To create a different patient bill of rights for those in public versus private managed care organizations
  - To create more opportunities for cross-cultural education for health care providers
  - To have physicians educate the public regarding the necessity of eliminating racial and ethnic disparities in health care
  - To increase the number of community health care workers and advocates who can assist patients in navigating the health care system
  - To increase the number of health care providers from racial or minority groups

Answer: A



## KEY CONCEPTS

- Physical and process characteristics of the current ED model can present a challenging environment for managing older patients and undermines the ability of the modern ED to serve as their care transition hub.
- Older patients are more likely to present with complex medical problems, receive a greater number of diagnostic tests and treatment regimens, have longer lengths of stay in the ED, require special needs during their visit, and be admitted more often.
- The new consensus-based GED guidelines were published to provide a standardized set of guidelines that can effectively improve the care of the geriatric population in the ED.
- The guidelines consist of 40 specific recommendations in 6 general categories: (1) staffing and administration; (2) equipment and supplies; (3) education; (4) policies, procedures, and protocols; (5) follow-up and transitions of care; and (6) quality improvement measures.
- The GED guidelines represent recommendations and are not intended as a mandate for every ED.

## CHAPTER e8: QUESTIONS &amp; ANSWERS

**e8.1.** What is the most rapidly growing segment of the US population according to age?

- A. 5–10 years
- B. 15–20 years
- C. 55–60 years
- D. 65–70 years
- E. Older than 85 years

**Answer: E.** The most rapidly growing segment of the population is the “oldest old,” aged 85 years and older, who will represent nearly 25% of Medicare beneficiaries by 2050.

**e8.2.** The geriatric ED (GED) guidelines developed by ACEP, SAEM, AGS, and ENA make recommendations in which of the following areas?

- A. All of these
- B. Education and patient care protocols
- C. Follow-up and transitions of care
- D. Quality improvement measures
- E. Staffing, supplies, and administration

**Answer: A.** The GED guidelines consist of 40 specific recommendations in six general categories: (1) staffing and administration; (2) equipment and supplies; (3) education; (4) policies, procedures, and protocols; (5) follow-up and transitions of care; and (6) quality-improvement measures.

**e8.3.** The geriatric ED guidelines recommend older adult-specific educational content in which of the following areas?

- A. All of these
- B. Atypical presentations of disease
- C. Cognitive and behavioral disorders
- D. Medication management
- E. Pain management and palliative care

**Answer: A.** See [Box e8.1](#)

## KEY CONCEPTS

- Palliative care is a physical, spiritual, psychological, and social support provided to patients and families at any stage of serious illness.
- Palliative care teams are specialized interdisciplinary teams that should be involved early in the course of illness.
- Hospice care is a care system for patients and families with a prognosis of 6 months or less if the disease runs its usual course; referral from the emergency department (ED) may be indicated.
- Patients at the end of life general follow one of four terminal illness trajectories: sudden death, organ failure, cancer, or frailty.
- Functional status is a strong predictor of decline and progression to death in patients with advanced illness.
- Goals of care conversations that outline patient and family hopes and expectations of interventions should be carried out.
- Emergency clinicians should make recommendations for care plans, interventions, and treatment courses based on prognosis, goals of care, and expected benefit to meet the identified goals of care.
- Key communication skills include breaking bad news, death disclosure, and assessment of goals of care.
- Interpretation of an existing advance care plan or receipt of a prehospital order (eg, POLST—**P**hysician **O**rders for **L**ife-**S**ustaining **T**herapy) should factor into ED treatment plans in the context of the patient's illness trajectory.
- Advance care planning may occur in the ED in the form of goals of care assessment followed by recommendations and orders placed by the emergency clinician to implement the plan.
- Symptom management is critical at the end of life; common symptoms are dyspnea, pain, delirium and agitation, and secretion management.

## CHAPTER e9: QUESTIONS &amp; ANSWERS

**e9.1.** Which of the following is expected to be the least likely cause of death for adults in the United States?

- A. Cancer
- B. Cardiovascular disease
- C. Heart disease
- D. Trauma

**Answer: D.** According to the Center for Disease Control, accidents are the 3rd leading cause of death in the United States. <http://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm>

**e9.2.** In a nondeath disclosure setting, deliverance of bad news should start with which of the following approaches?

- A. Allowing the patient to react to the news
- B. Asking the patient if he or she wants to know
- C. Making sure you keep the conversation going to provide comfort and thereby dull the emotional impact of the news
- D. Your knowledgeable of the complete medical implications and ramifications of the news

**Answer: B.** Respectful disclosure of breaking difficult news includes assessing the readiness and willingness of the patient to receive the news. *Oncologist*. 2000;5(4):302–11

**e9.3.** Mr. Jones is a 54-year-old man currently receiving hospice care at home for advanced colon cancer. His wife calls 911 when he becomes unresponsive. On presentation to the ED, his vital signs are blood pressure, 60/40 mm Hg; heart rate, 140 beats/min; temperature, 39.6°C (103.3°F); respiratory rate, 12 breaths/min. He is moaning with facial grimace. His wife, who is the legal decision maker, is at the bedside. Which of the following represents the best course of action?

- A. Initiate sepsis protocol, begin treatment for pain, and call the palliative care service.
- B. Initiate sepsis protocol, page the hospice nurse, and speak to his wife regarding goals of care.
- C. Page the hospice nurse, begin treatment for pain, and speak to his wife regarding the goals of care.
- D. Page the hospice nurse and speak to his wife regarding the goals of care.

**Answer: C.** Under the hospice benefit, the hospice agency is the care manager. The patient has lost capacity and his wife is his decision maker and she should be consulted regarding goals. Pain

and non-pain symptoms should be addressed while other actions are being taken.

**e9.4.** Mrs. Smith is a 68 year-old woman with advanced heart failure who presents to the emergency department in cardiogenic shock with multiple previous admissions that state that she is currently optimized with all available therapies. You would like to initiate hospice care from the emergency department. Which of the following do you do next?

- A. Call the hospice liaison on call for the ED to speak with her family regarding their options.
- B. Call the palliative care service to discuss hospice care with the patient and her family.
- C. Conduct a goals of care discussion with the patient and her family.
- D. Discuss the benefits of hospice care that would allow the patient to stay at home with her family.

**Answer: C.** Central to the discussion of hospice care is an assessment of the goals of care focused on care that addresses the distress of the illness and not the reversal of the primary illness.

**e9.5.** In performing a death disclosure, which of the following statements represents best practice when communicating news of death?

- A. "Your loved one didn't make it."
- B. "Your loved one has died."
- C. "Your loved one has gone to a better place."
- D. "Your loved one has passed on."

**Answer: B.** It is not recommended to use euphemism or unclear statements to communicate news of death as this can cause confusion and ambiguity for the receiver of the news.

**e9.6.** Mr. Stone is a 27 year-old man with glioblastoma multiforme. He has completed radiation and is on oral chemotherapy. Over the last week, he has become progressively weaker and is now in bed. He is no longer speaking and is dropping things. He is taking sips of clear liquids and coughs after swallowing. Which of the following is the strongest predictor of his death?

- A. Aspiration risk
- B. CT scan that shows progression
- C. Deterioration of speech
- D. Functional status

**Answer: D.**

**e9.7.** Mr. Samuels is a 46 year-old man with severe breathlessness and anxiety due to advanced chronic obstructive pulmonary disease. His vital signs are temperature, 36.8° C (98.2° F); blood pressure, 110/60 mm Hg; heart rate, 115 beats/min; respiratory rate, 34 breaths/min; oxygen saturation, 98% on room air. He is visibly anxious and reports dizziness and dyspnea. Which of the following is the best initial treatment?

**A.** IV fluids

**B.** Lorazepam

**C.** Morphine

**D.** Oxygen

**Answer: C.** In the absence of hypoxia, morphine has been shown to relieve the sensation of breathlessness. Benzodiazepines have not been shown to relieve breathlessness and may increase side effects.

## KEY CONCEPTS

- Bioethics is a method of using values and moral principles to come to defensible decisions for ethical dilemmas.
- Ethical dilemmas arise from conflicts between multiple good options or multiple bad options, not between good and bad choices.
- Individual rights come from another's duty to act.
- Values come from a variety of sources: community, culture, religion, and family.
- The values driving medical decisions should be the patient's values.
- Basic ethical principles include autonomy, beneficence, nonmaleficence, justice, and confidentiality.
- In emergency medicine, caregiver safety is an important value.
- A rapid ethical decision tool: Is there an established precedent? If not, apply the following three tests: the impartiality test, the universality test, and the interpersonal justifiability test.
- Consent requires decision-making capacity or appropriate surrogate decision makers.
- Futility, although an appropriate reason for withholding nonproductive interventions, is not an excuse for withholding compassionate care.
- There are many areas of emergency medicine with unique ethical issues, such as resuscitation research, disaster response, morality of triage, response to high-risk situations, and wilderness medicine.

## CHAPTER e10: QUESTIONS & ANSWERS

**e10.1.** "Confidentiality" is all of the following *except*:

- A. Describes the patient's right to sufficient physical and auditory isolation so that they cannot be seen or heard by others during interactions with medical personnel.
- B. Imposes a duty on health care workers.
- C. May conflict with the law, especially public health statutes.
- D. Presumes that what the patient tells the physician will not be revealed to any other person or institution without the patient's permission.

**Answer: A.** While isolation of patients for confidentiality is a good goal the limited space and hectic nature of an ED would some times prevent timely and quality care.

**e10.2.** Which of the following can emergency clinicians always rely on for appropriate guidance when faced with ethical dilemmas?

- A. State laws and medical board policies
- B. The American College of Emergency Physicians' (ACEP) Code of Ethics
- C. The Hippocratic Oath
- D. None of the above.

**Answer: D.** All of these examples are great for guidance on ethical dilemmas none of them can "always" have guidance for every situation that can occur.

**e10.3.** To have adequate decision-making capacity in any particular circumstance, a person must understand all of the following *except*:

- A. The available options
- B. The consequences of acting on those options

- C. The costs and benefits of consequences in relation to a relatively stable framework of personal values and priorities
- D. The court's decision about their competency

**Answer: D.** To be deemed competent an individual must under stand A, B, and C. Answer D is a legal issue and is not required for competency.

**e10.4.** Withholding treatment in the emergency department (ED):

- A. Legally differs from withdrawing treatment.
- B. Morally differs from withdrawing treatment.
- C. Requires clinical information that is often unavailable immediately.
- D. Should never be done.

**Answer: C.** In an emergency not all relevant information is available at the time important decisions must be made.

**e10.5.** When using the "rapid approach to ethical problems in the emergency department (ED)" to decide on a course of action:

- A. Always consult with the Bioethics Committee/Consultant before acting.
- B. Assume that each ethical problem in the ED requires a unique solution.
- C. Test your chosen action against your religious values.
- D. When practicable and safe for the patient, buy time to consult on possible options.

**Answer: D.** Ethical problems can often take some time to work out, but a rapid approach rarely has enough time for a formal ethics consult. Buying some time so a reasonable solution can be derived is often the best that can be done.

## KEY CONCEPTS

- Emergency Medical Treatment and Active Labor Act (EMTALA) governs virtually every aspect of hospital-based emergency services. Hospitals and emergency clinicians need to address the following issues to ensure compliance with the law:
  - Adopt (and enforce) a hospital-wide EMTALA policy, as well as emergency department (ED)–specific policies.
  - Educate all appropriate hospital staff and medical staff.
  - Define the hospital's standard ED medical screening examination (MSE) process, including identifying "dedicated emergency departments" and designated "qualified medical personnel" to perform the MSE, as defined by the government.
  - Establish the hospital's patient stabilization procedures and documentation.
  - Do not delay access to the MSE, stabilizing care, on-call physicians, or transfer on account of or to inquire about the patient's insurance status (EMTALA's "no-delay" provision).
  - Address the ED/outpatient registration procedures and payment collection systems.
  - Implement processes and procedures regarding patient refusal of the MSE, stabilizing treatment, or transfer.
  - Implement an effective ED physician on-call system, with written duties and responsibilities.
  - Create a uniform system and "transfer packet" for transferring patients out of the hospital.
  - Create a system for accepting or rejecting patient transfers from other facilities.
  - Institute appropriate documentation requirements for ED medical records, a "central log" for patients presenting to the hospital, transfers, and on-call lists.
- Post required "signs" in areas used for MSEs, including the ED, Labor and Delivery, and psychiatric intake centers.
- Monitor and quality assurance review the hospital's EMTALA compliance.
- Draft a policy and procedure to report suspected EMTALA violations to Centers for Medicare and Medicaid Services (CMS).
- Review the potential application of EMTALA to the hospital's outlying facilities, such as Urgent Care Centers, or Ambulance/Helicopter EMS Services.
- Review disaster plans and public health emergency responses for EMTALA issues.
- Draft and use legally-approved EMTALA forms to achieve/document compliance.
- Whenever emergency clinicians are in doubt about the legality of a situation, they should "do what you believe to be in the patient's best interest and worry about the legal consequences later."
- Consent for minors in the ED is really a non-issue. Consent is a creature of state law; EMTALA pre-empts state law, and it requires the ED to provide a MSE and stabilizing treatment to all minors presenting to the ED.
- Emergency clinicians should be reticent to allow patients to leave the ED against medical advice. The capacity to make reasonable medical decisions can easily be affected by alcohol, drugs, pain, or any number of medical conditions. "When in doubt, don't let 'em out" should be the guiding principle. The courts (and public opinion) will bend over backward to protect clinicians who act in the best interests of the health and safety of their patients.



## CHAPTER e11: QUESTIONS & ANSWERS

- e11.1. Which of the following is a common source of liability for failure to comply with the Emergency Medical Treatment and Active Labor Act (EMTALA):
- A. Failure to comply with written hospital policies and procedures.
  - B. Failure to diagnose an emergency medical condition (EMC).
  - C. Failure to properly treat an admitted patient who is boarded in the emergency department (ED) while waiting for an intensive care unit (ICU) bed to become available.
  - D. Failure to stabilize a patient after admission to an inpatient unit.
  - E. All of the above.

**Answer: A.** Hospital policies become the hospital's standard under EMTALA. Thus, failure to comply with written policies, what Dr. Bitterman terms "failure to follow your own rules," becomes an EMTALA violation when the policies are related to the medical screening and stabilization of patients in the ED.

- e11.2. Which of the following violates the Emergency Medical Treatment and Active Labor Act (EMTALA):
- A. A 7-hour wait after triage to be medically screened by the emergency clinician.
  - B. Boarding an admitted patient in the emergency department (ED) for 72 hours after the patient's physician has accepted the patient for admission.
  - C. Delaying the patient's access to an ED bed by declining to promptly accept the patient from an arriving emergency medical service (EMS) unit or by failing to *immediately* triage or evaluate the patient to determine if the patient can wait on a stretcher with the EMS folks until a bed becomes available.
  - D. Delaying the patient's medical screening examination (MSE) in the ED to triage the patient, and then for the emergency clinician to see the patients in the order based on the triage nurse's perception of the patients' acuity.

**Answer: C.** Centers for Medicare and Medicaid Services (CMS) guidelines require the hospital to *immediately* triage ambulance patients arriving to the hospital's ED.

- e11.3. A 73-year-old woman is brought by private ambulance to the emergency department (ED) for shortness of breath. Due to ED overcrowding, there are several ambulance stretchers in line ahead of her at triage. At what point does the hospital "accept responsibility" for this patient?
- A. When she was placed in the ambulance
  - B. When the ambulance arrived at her home
  - C. When the ambulance arrived on hospital property

- D. When the patient is seen by the emergency clinician
- E. When the patient is seen by triage personnel

**Answer: C.** The Emergency Medical Treatment and Active Labor Act (EMTALA) defines the time of acceptance of responsibility as when the patient "comes to the ED." In its EMTALA regulations, the Centers for Medicare and Medicaid (CMS) defines the term "comes to the ED" to include anywhere on hospital property, so the hospital's duty and responsibility for the patient is triggered when the ambulance arrives on hospital property.

- e11.4. A physician on-call for the hospital's emergency department (ED) has a duty *under the Emergency Medical Treatment and Active Labor Act (EMTALA)* to come to the ED under which of the following circumstances?
- A. If asked to help stabilize a patient in the ED who has an emergency medical condition (EMC)
  - B. To help transfer a stable patient to another acute care hospital that has a specialist available that is not available at the transferring hospital
  - C. When asked to consult on a patient who has been stabilized in the ED and is being admitted by the patient's primary care physician
  - D. Whenever requested to come to the ED by the emergency clinician on-duty
  - E. All of the above

**Answer: A.** Under the EMTALA, the on-call physician only has duty to come to the ED if needed to help determine whether the patient has an EMC or to stabilize an EMC. Any other requirements concerning when the on-call physician must come to the ED are governed by state law and/or by the hospital's medical staff by-laws, not by EMTALA.

- e11.5. According to the Centers for Medicare and Medicaid Services (CMS), which of the following patients may a hospital with specialized capabilities and available capacity refuse to accept in transfer solely because the patient is uninsured?
- A. A patient with an unstable emergency condition admitted to observation at another hospital that is unable to stabilize the patient's condition
  - B. Any patient the hospital chooses to reject
  - C. An emergency department (ED) patient with an unstable emergency condition who is at another hospital that is unable to stabilize the patient
  - D. An inpatient with an unstable emergency condition at another hospital that is unable to stabilize the patient

**Answer: D.** CMS guidelines state that hospitals do not have to accept an "inpatient," as defined by CMS, in transfer from another hospital under any circumstances, even if its decision to decline to accept the patient in transfer will result in the patient's death.

## KEY CONCEPTS

- Be cognizant that the work of health care occurs within a complex socio-technical system composed of five interrelated components: people, tasks, technology and tools, physical environment, and organizational conditions. A change in even one component has an impact on other parts of the work system and, ultimately, safety.
- Don't count errors. Patient safety and mitigation of risk emerges from multifactorial interactions within the clinical work system. Incidents of patient or staff harm are most often the result of system failures, not individual human error.
- Process improvements to clinical care often have "unintended consequences" elsewhere within the work system. Partner with cognitive, behavioral, social scientists and engineers to reduce the likelihood of this and improve adoption by workers.
- Don't set up reporting systems without the resources to fully analyze the reports.
- Safety is a complex dynamic "non-event" requiring minute-to-minute risk mitigation. Don't look for technological "quick fixes" for creating safety within health care.

## CHAPTER e12: QUESTIONS &amp; ANSWERS

**e12.1.** Teamwork failures in emergency medicine are involved in approximately what percentage of malpractice cases?

- A. 10%
- B. 20%
- C. 30%
- D. 40%
- E. 50%

**Answer: D.** The lack of cross-monitoring by team members and the failure to demonstrate advocacy or assertion on behalf of the patient by caregivers in avoidance of harm are two of the most frequent factors cited.

**e12.2.** A 27-year-old woman presents with complaints of back pain. She has been to the emergency department (ED) a number of times for this same complaint. On the way to the medical screening examination, the emergency clinician is heard to mutter, "She's a drug seeker." This is an example of which potentially negative process?

- A. Authority gradient
- B. Cognitive framing
- C. Countertransference
- D. Fatigue and shift work
- E. Visceral bias

**Answer: E.** In addition to cognitive mental properties and the effects of fatigue/shift work, the emotional state of the physician can affect his or her decision making. This has been referred to as *visceral bias*. Health care workers are often less aware of the presence/function of factors such as economy of perception that may lead to stereotyping and adversely affect clinical interactions.

**e12.3.** Rational approaches to shift work include all of the following *except*:

- A. Exercise
- B. Forward rotating schedules
- C. Sedatives
- D. Use of sleep-friendly rooms (eg, dark cloth or blinds, white noise, ear plugs, family awareness of need to sleep)

**Answer: C.** Sedatives. The use of sedatives and/or alcohol should be avoided because each affects the effectiveness of sleep between shifts and therein the overall risk of medical errors and patient harm while working shift hours due to fatigue.

**e12.4.** Factors that affect emergency department (ED) performance and increase vulnerability to failure *include*:

- A. Low-density decision-making, poor teamwork, low workload, hunger
- B. Overcrowding, high levels of uncertainty, fatigue, ED layout
- C. Overstaffing, low cognitive load, production pressure, low numbers of transitions in care
- D. Physician salaries, consultation rates, multiple interruptions, medication shortages

**Answer: B.** Many intrinsic and extrinsic factors affect an ED's performance, undermining its functioning and making it more at risk for a medical mishap or patient harm (see [Table e12.1](#)). Although each choice contains at least one of these performance-affecting factors, only choice B contains four of the factors.

## KEY CONCEPTS

- Stress is a part of the human experience. The practice of emergency medicine, because of its unpredictable and chaotic nature, and because matters of life and death occur every shift, includes more stressors than most other professions.
- Emergency clinicians experience high rates of burnout and compassion fatigue, which threatens the future of the specialty.
- The approach to preventing burnout and promoting resilience must be multifaceted and involve institutional, professional, and personal strategies. Only by being specific and concrete in proactively creating a more supportive, efficient, and fulfilling work environment will health care institutions be successful in promoting physician wellness.
- At the departmental level, emergency medicine leaders should educate physicians, whether in practice, in residency, or in medical school, to cultivate resilience to meet the challenges that they will face.
- Emergency clinicians should take personal responsibility and develop the skills that they need to have long and satisfying careers in emergency medicine.